INSTRUCTION MANUAL

VP-5102B

10MHz Dual-trace Oscilloscope

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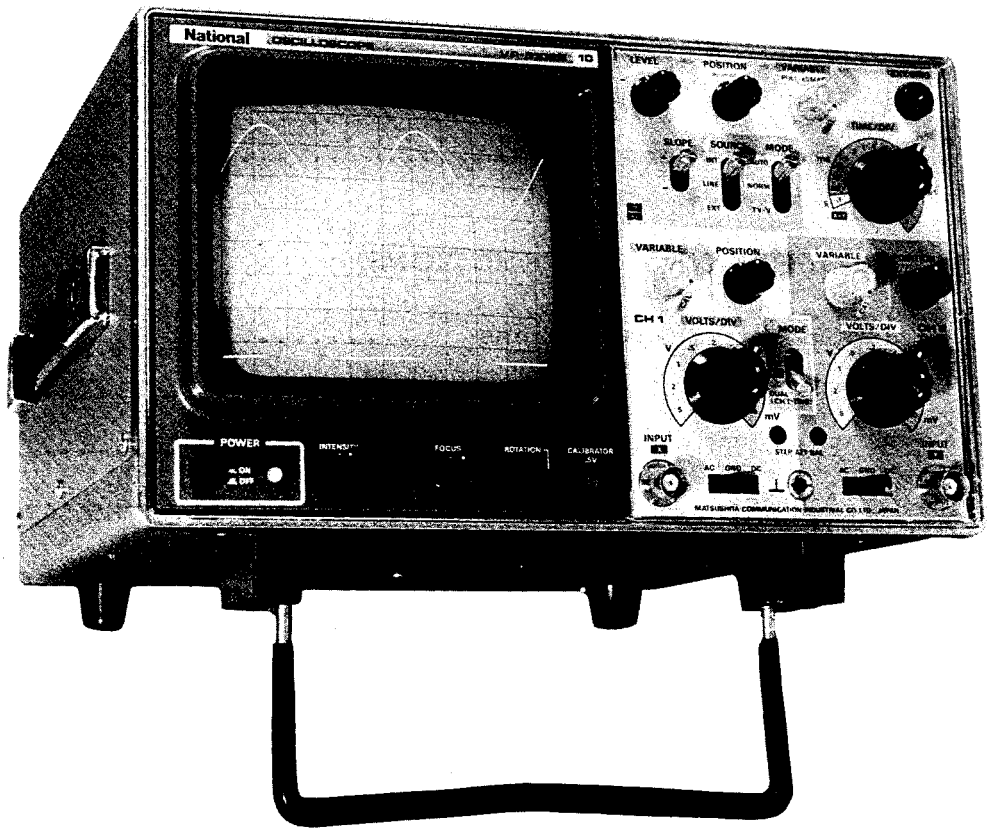
Section 1. SPECIFICATIONS



1.1 Features

(1) Dual-trace Display
(2) DC-10 MHz Bandwidth (-3 dB)
(3) 10 mV/DIV Sensitivity
(4) Internal Graticule CRT
(5) Calibrated X-Y Operation
(6) Built-in x5 Sweep Magnifier
(7) AUTO Sweep Selector
(8) TV Waveform Observation
(9) Built-in Amplitude Calibrator
(10) Frontpanel Trace Rotation Control
(11) Regulated Power Supply
(12) Compact Size (26 cm depth) and Light Weight (5 kg)

1.2 Specifications

Vertical Deflection

Sensitivity:	10 mV to 5V/DIV in 9 calibrated steps in 1-2-5 sequence; accuracy, within ±4%; VAR control, continuously variable between steps and to 12.5 V/DIV
Bandwidth (-3 dB):	DC coupling, DC to 10 MHz AC coupling, 5Hz to 10 MHz
Rise time:	35 nsec
Input impedance:	1 MΩ paralleled by approx. 32 pF
Display mode:	CH1 (X), CH2 (Y), DUAL
Chopping rate:	200 kHz ± 30%
Maximum input voltage:	600 V peak (DC + AC peak) for 10 seconds
Input coupling:	AC-GND-DC

Triggering

Trigger mode:	AUTO, NORM, (TV-V)
Trigger source:	INT, LINE, EXT
Slope:	Positive or negative
Internal trigger sensitivity:	0.4 DIV, *30 Hz to 2 MHz 1.5 DIV, to 10 MHz 1.0 DIV, composite sync signal (TV-V)
External trigger sensitivity:	0.2 Vp-p, *30 Hz to 2 MHz 0.75 Vp-p, to 10 MHz 0.5 Vp-p, compositive sync signal (TV-V)

(* 50 Hz at AUTO SWEEP)

External trigger input:	Maximum input voltage, 600 V peak (DC+AC peak for 10 seconds), input impedance, 500 kΩ or more (AC coupling)

Horizontal Deflection

Sweep rate:	0.5 μsec to 0.1 sec/DIV in 17 calibrated steps in 1-2-5 sequence (TV-H, 10 μsec/DIV) plus X-Y;accuracy, within ±5% VAR control, continuously variable between steps and to 0.2 sec/DIV
Sweep magnifier:	x5 (at 0.5 μsec, maximum sweep rate is 0.1 μsec/DIV)

X-Y Operation (CH1 X, CH2 Y)

Sensitivity:	10 mV to 5 V/DIV in 9 calibrated steps in 1-2-5 sequence; accuracy, within ±5%; VAR control, continuously variable between steps and to 12.5 V/DIV
Bandwidth (-3dB):	X (CH1), DC to 500 kHz Y (CH2), DC to 10 MHz
Input impedance:	1 MΩ paralleled by approx. 32 pF
Maximum input voltage :	600 V peak (DC + AC peak) for 10 seconds
X-Y phase difference:	3° or less at 10 kHz

Amplitude Calibrator

Output voltage:	0.5 V p-p, square wave
Repetition rate:	Line frequency

Cathode Ray Tube

Type:	140 AYB31 (P31 phosphor), internal graticule
Display area:	8 x 10 DIV (9.5 mm/DIV)
Accelerating potential:	Approx. 1.5 kV

Power Requirements

Line voltage:	AC 100, 115, 230 V $\pm$ 10%
Line frequency:	50 to 60 Hz
Power consumption:	Approx. 33 W (41 VA)

Dimensions & Weight

Dimensions:	148 (H) x 260 (W) x 260 (D) mm
Weight:	Approx. 5 kg

Accessories

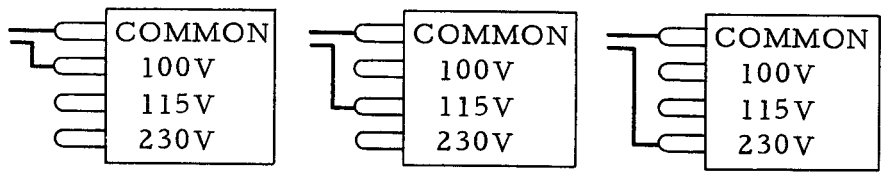
Standard:	BNC adaptor (2 pcs), Spare fuse one for High Voltage (1A) (230V line voltage only) another one for Line Voltage (1A, 115V) (0.5A, 230V) Hexagon wrench (2pcs) 1.5mm for V variable knob 5/64 inch for Time/DIV knob Instruction manual
Option:	VQ-054K3010 10:1 probe VQ-036M BNC adaptor (with earth terminal)

Section 2. OPERATING INSTRUCTIONS

2.1 Operating Precautions

Operating voltage

This instrument operates at a 100 V, 115 V, or 230 V ±10% AC, 50 to 60 Hz line-voltage source. The applied voltage is indicated on the rear panel. To convert from the specified voltage to other line voltages, resolder the primary taps of power transformer, referring to the figure below and change the rearpanel applied voltage indication. Also, be sure to replace the fuse to correspond with new line voltage, 1 A fuse for 100 V to 115 V operation and 0.5 A fuse for 230 V operation. If it is not wired to your local line voltage, set the power transformer wiring as shown below.



AC100V AC115V AC230V

Allowable input signal voltage

The maximum voltage that can be applied to the INPUT (7) or EXT TRIG (16) connector is 600 V peak including the DC component for 10 seconds. The oscilloscope circuitry may be damaged if the input voltage exceeds the maximum voltage.

High voltage

Cut off the power to disable the high voltage circuit when removing the case.

NOTES

1. Keep the instrument away from strong magnetic fields which may cause the electron beam inside the CRT to be deflected and distort the waveform being measured.

2. As the VP-5102A does not employ a ventilating fan, do not put books, papers and other items on the oscilloscope to assure good ventillation.

3. Warm up the instrument more than 15 minutes for accurate measurement.

2.2 Front Panel Controls and Connectors

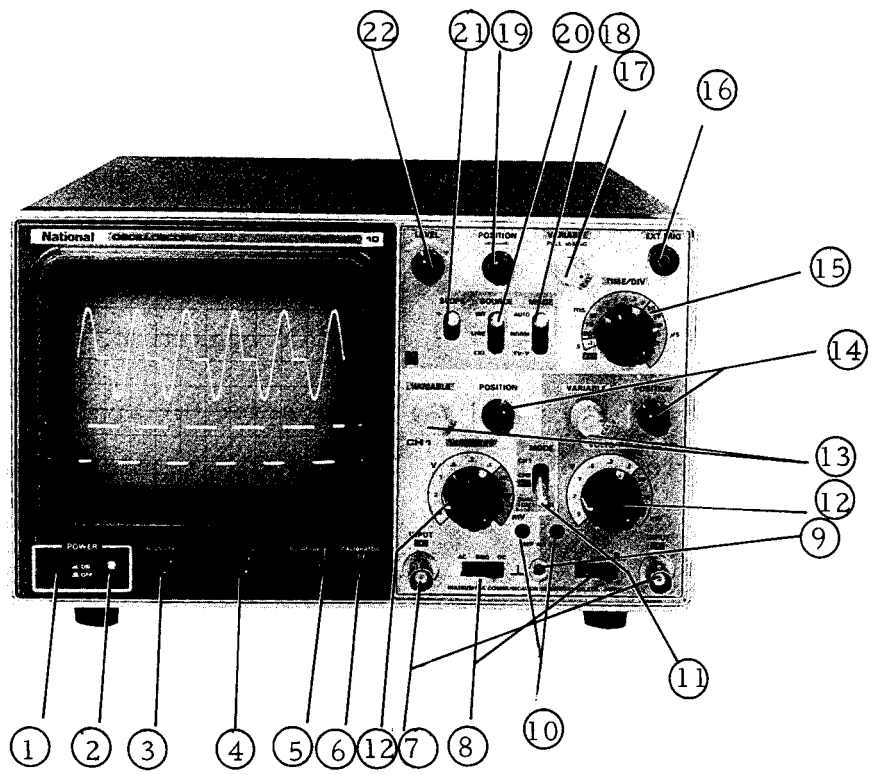


Fig.2-1 Front Panel

①	POWER switch	- Power is on when this switch is pushed.
②	Pilot lamp	- Light turns on when power is supplied.
③	INTENSITY control	- Used to adjust the brightness of the display. When this knob is rotated clockwise, the display becomes brighter.
④	FOCUS control	- Used to adjust the focus of the trace or spot.
⑤	ROTATION control	- Trace rotation screwdriver adjustment. Aligns trace with the horizontal graticule lines.
⑥	CALIBRATOR .5V	- Provides a squarewave signal of approximately 0.5 Vp-p at the line frequency for compensation of voltage probes.
⑦	INPUT (X) connector	- Connector for applying an input signal to the CH1 vertical deflection system. It can be used as X-axis input connector in X-Y operation.
	INPUT (Y) connector	- Connector for applying an input signal to the CH2 vertical deflection system. It can be used as Y-axis input connector in X-Y operation.
⑧	AC-GND-DC selector	- Selects the input coupling mode AC; Signals are coupled through capacitor and DC signal component is blocked.

GND;
Connects the input of vertical amplifier to ground to provide a ground reference display.

DC;
All components of input signal are provided to the vertical amplifier.

⑨ Ground terminal - Grounded to the housing.

⑩ STEP ATT BAL control - Screwdriver adjustment. When properly set, it prevents trace shift when switching the VOLT/DIV selector ⑫ between the steps.

⑪ MODE selector - Use this to select the operating mode of the vertical axis.

CH1 For CH1 operation. The trigger signal is also set automatically to CH1.

CH2 (X-Y) - For CH2 operation. The trigger signal is also set automatically to CH2.
Always set the lever to this position for X-Y operation.

DUAL - For simultaneous CH1 and CH2 operation. The trigger signal is set to CH1 and so triggering is performed with the signal applied to CH1.
Dual-trace operation is performed as follows in accordance with the position of the TIME/DIV selector ⑮

0.1sec - 0.2ms/DIV - CHOP mode: each channel is displayed at a repetition rate of about 200kHz. Used for observation of low frequency dual-trace signals. 0.1msec - 0.5μsec/DIV - ALT mode: each channel is displayed on alternate sweeps. Used for observation of high frequency dual-trace signals.

⑫ VOLTS/DIV selector - Selects the vertical deflection factor from 10 mV/DIV to 5 V/DIV in 1-2-5 sequence in 9 ranges.

⑬ VARIABLE control - Varies the vertical deflection factor between the steps. Extends the maximum deflection factor to 12.5 V/DIV in the 5 V/DIV position. Provides calibrated deflection factor in the fully clockwise position, CAL.

⑭ V POSITION control - Controls the vertical position of the display.

⑮ TIME/DIV selector - Selects calibrated sweep rates from 0.5μsec/DIV to 0.1 sec/DIV in 17 ranges.

⑯ EXT TRIG connector - Input terminal for external trigger signals

⑰ VARIABLE control - Varies the sweep rates between the steps. The sweep rates are calibrated in the fully clockwise position, CAL.

Furthermore, when this knob is pulled out, display will be magnified by 5 times horizontally and at the same time, the sweep rate is reduced to one-fifth.

⑱ MODE selector - This is used to select the trigger circuit mode.

AUTO - Sweep freeruns in absence of a trigger signal.

NORM - When triggered, sweep starts and signal can be displayed.

TV-V - Basically the same as the NORM mode. A low-pass filter is coupled in the trigger signal line to take out the sync components of the vertical video signal, and it becomes possible to trigger the vertical video composite signal.

⑲ H POSITION control ◀▬▶ - Controls the horizontal position of the display.

⑳ SOURCE selector - Selects the source of trigger signal

INT;

Trigger signal is derived from the "" signal displayed on the screen.

Used for ordinary observation.

LINE;
Trigger signal is derived from a line signal applied to the instrument. Used for measurement of DC voltage for instance, as well as observation of noise from the line.

EXT;
Trigger signal is derived from an external signal applied to EXT TRIG terminal (16), so that sweep is triggered regardless of fluctuation of a signal observed on the screen.

(21) SLOPE selector - Selects the positive - or negative-going slope of the trigger waveform.
+:The sweep starts from the positive-going portion of the trigger signal.
-:The sweep starts from the negative-going portion of the trigger signal.

(22) LEVEL control - Level of triggering point is adjusted.

2.3 First Time Operation

2.3.1 Preparation for use

Plug the power supply cord into an AC outlet. The AC voltage should be the same as the power voltage of the oscilloscope.

2.3.2 Switch on the power and start sweep

(1) Set the front panel controls as follows (refer to Fig.2.2.a)

INTENSITY control ③	Rotate fully clockwise
FOCUS control ④	Center
POSITION ⑭	Center
POSITION ⑲	Center
TIME/DIV selector ⑮	1msec/DIV
VOLTS/DIV selector ⑫	50mV/DIV (for both CH1, CH2)
MODE selector ⑪	DUAL
MODE selector ⑱	AUTO

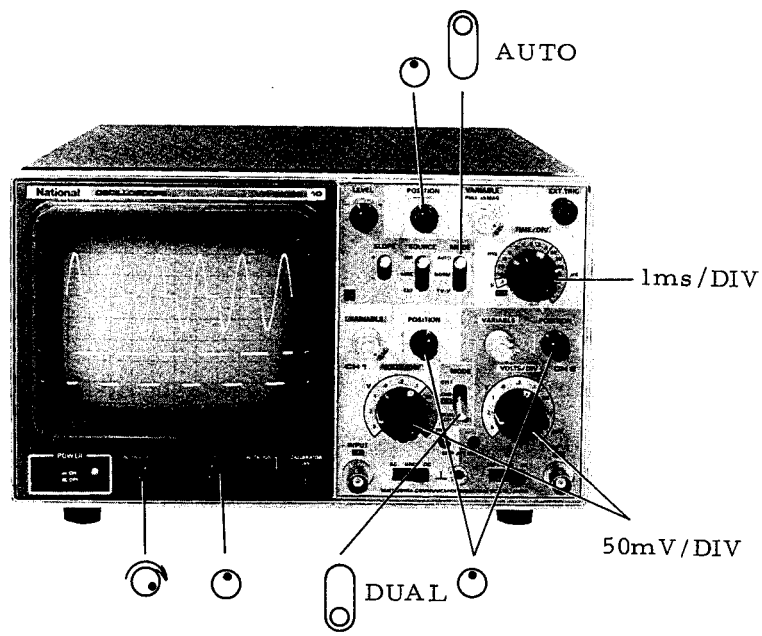


Fig.2.2.a Set the controls as per this figure

(2) Push on the POWER switch ① to switch on the instrument. A trace will appear on the CRT in a few seconds.

(3) Perform the following adjustments with the instrument set up as above.

INTENSITY control (3)	Adjust the display to the appropriate brightness.
FOCUS control (4)	Adjust the displayed trace focused.
ROTATION control (5)	Adjust the trace so that it is in parallel with the horizontal graticule lines.
STEP ATT BAL control (10)	Memorize the position of the trace and set the VOLTS/DIV selector (12) to 10mV/DIV. Adjust the STEP ATT BAL control (10) and bring the trace back to its original position. Perform this adjustment several times and until the trace does not shift when the VOLTS/DIV selector (12) is switched.

2.3.3 Trigger applied signal

(1) Connect the signal to be measured to the INPUT connector (7). Fig.2.2.b shows examples of such a connection. (When BNC adaptors are used, and the measuring lead wires are long, always twist the input signal lead with the ground wire to make it free from influence of noise and parasitic oscillation.)

(2) Set the AC-GND-DC selector (8) to AC or DC.

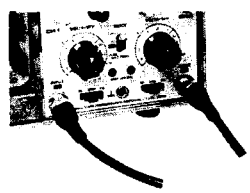
(3) Set the VOLTS/DIV selector (12) so that the trace can be observed.

(4) Set the SOURCE selector (20) to INT.

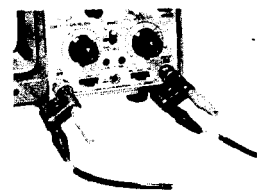
(5) Use the LEVEL control (22) to adjust the level of the triggering point.
The internal triggering signal source is automatically selected by the operation of the MODE selector (11) (refer to Table 2. 1). Therefore, in dual-trace operation (DUAL), input signals are triggered with the signal applied to CH1.

(6) Set the SLOPE selector (21) to the desired slope.

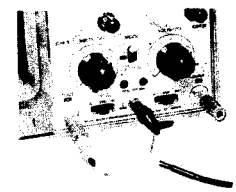
(7) Set the TIME/DIV selector (15) so that the trace can be observed easily.



BNC cords (options)



VQ-036M BNC adaptors with earth terminal (options)



BNC adaptors (supplied accessories)

Fig. 2. 2. b Connections to the INPUT connector

(11) MODE	Internal trigger signal
CH1	NORM (CH1)
CH2	NORM (CH2)
DUAL	CH1

Table 2. 1 Select the internal trigger signal

2.3.4 AUTO operation

(1) Set the MODE selector (18) to AUTO, and the sweep freeruns automatically by means of the internal oscillator in absence of a trigger signal, or when the signal is not triggered. This operation is convenient for measuring DC levels and for checking waveforms on the CRT until the triggering point is synchronized.
When observing an input signal with a frequency of less than 50 Hz, of which period is long, the sweep often freeruns before the next triggering point. Set the MODE selector (18) to NORM for triggering with this type of waveform.

2.3.5 Using LINE and EXT triggering

(1) Set the SOURCE selector (20) to LINE or EXT. The trigger signal sources and applications are listed in Table 2.2.

SOURCE (20)	Trigger signal source	Application
LINE	Power line voltage signal becomes triggering signal by internal connections.	For triggering with power line voltage For observing waveforms of power supply noise
EXT	Signal applied to EXT TRIG connector (16) becomes triggering signal.	For triggering by the signal applied to EXT TRIG connector (16).

Table 2.2 Trigger signal source

2.3.6 Sweep magnification

(1) Pull out the VARIABLE control (17).
In this mode, the sweep around the center of the CRT is magnified horizontally by 5 times. At the same time, the sweep rate also becomes 5 times, and the readout value of the time base becomes one-fifth.

2.3.7 Dual trace operation

(1) Set the MODE selector (11) to DUAL when observing two waveforms simultaneously:
This instrument is a dual-trace oscilloscope and the operating mode of CH1 and CH2 is determined automatically by the position of the TIME/DIV selector (15). (Refer to Table 2.3)

TIME/DIV (15)	CH1/CH2 operating mode	Operation
0.1 sec ~ 1msec/DIV	CHOP	CH1 and CH2 signals are displayed at a repetition rate of about 200kHz.
0.1msec ~ 0.1μsec/DIV	ALT	CH1 and CH2 signals are displayed on alternate sweeps.

Table 2.3 CH1/CH2 operating mode

2.3.8 X-Y operation

(1) Adjust the STEP ATT BAL controls (10) for both CH1 and CH2. Refer to 2-3-2 (3) for the procedure. If this adjustment is not performed properly, the trace may not deflect across the whole of the screen.

(2) Set the controls as follows:

MODE selector (11) CH2

TIME/DIV selector (15) ..... X-Y

The instrument now operates as an X-Y oscilloscope with a maximum deflection factor of 10mV/DIV for both the X and Y axes.

Table 2. 4 shows the inputs and position controls.

Input signal		Position controls
X axis	INPUT (CH1)	↔ POSITION (19) ↕ POSITION (CH1) control (14) does not function.
Y axis	INPUT (CH2)	↕ POSITION (CH2) (14)

Table 2.4 Inputs and position controls in X-Y operation

2.4 Applications

2.4.1 Adjustments required before measurement

Conduct the following adjustments before measurement in order to ensure accurate and reliable measurement.

1) Gain adjustment

Set the controls as follows:

VOLTS/DIC selector (12)	0.1V/DIV
VARIABLE control (13)	Rotate fully clockwise to CAL position
TIME/DIV selector (15)	10msec/DIV
VARIABLE control (17)	Rotate fully clockwise to CAL position

Connect the CALIBRATOR (6) signal to the CH1 and CH2 INPUT connectors (7), and adjust the GAIN ADJ control on the bottom of the instrument using a screwdriver so that the screen width is set to 5 DIV.

2) Probe compensation

When observing signal waveforms with a low signal power (high output impedance), the signal source is adversely affected by the input impedance of the oscilloscope, by the distributed capacity of the coupling wires, or by induced noise, etc., and these factors are the cause of measurement errors. In such a case, use an attenuation probe (high-impedance type probe).

For an operation like this, it is necessary to compensate the input capacitance of the probe.

Set the VOLTS/DIV selector (12) to 10mV/DIV and then connect the tip of the probe to the CALIBRATOR connector (6).

When using a 10.1 probe (Fig. 2. 3), check that the waveform amplitude is 5 DIV and adjust the input capacitance of the probe with a small screwdriver so as to obtain a normal waveform similar to that shown in Fig. 2. 4.

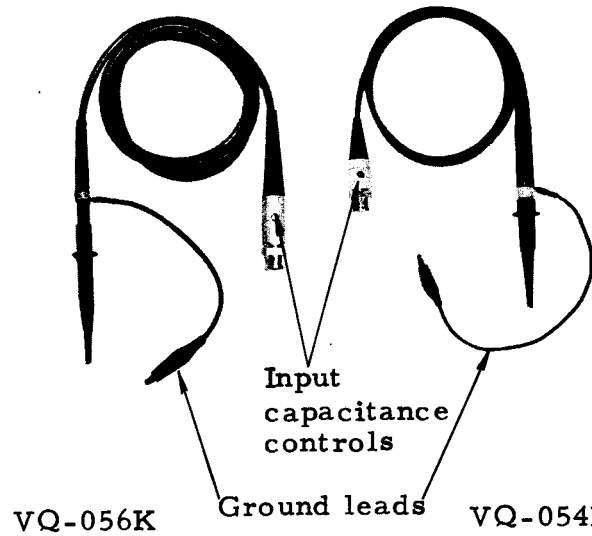
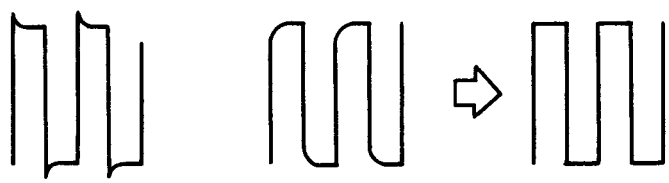


Fig. 2. 3 10: 1 probe recommended for use with VP-5102A



Waveforms when the input capacitance control is not properlv adjusted

Normal square waves properly adjusted

Fig. 2.4 Probe input capacitance adjustment

Remember that the VOLTS/DIV selector (12) indication display must be magnified by 10 times when using a 10:1 probe. (Refer to an example).

Example

VOLTS/DIV (12)	Screen amplitude	Probe magnification	Measurement value
10mV/DIV	x 5 DIV	x 10 (10:1)	= 0.5V

2.4.2 DC component voltage measurements

Set the VOLTS/DIV selector (12) to an appropriate position. Set the AC-GND-DC selector (8) to GND and set the zero level to an appropriate position with the POSITION control (14).
If the AC-GND-DC selector (8) is set to DC, a trace corresponding to the DC voltage components only will shift across the screen. The DC voltage can be measured by observing how far the trace has shifted.
The measurement example in Fig. 2.5 involves the following settings and calculation:

VOLTS/DIV selector (12) ------ 5V/DIV

VARIABLE control (13) ------- CAL

5V/DIV x 3.5DIV = 17.5V

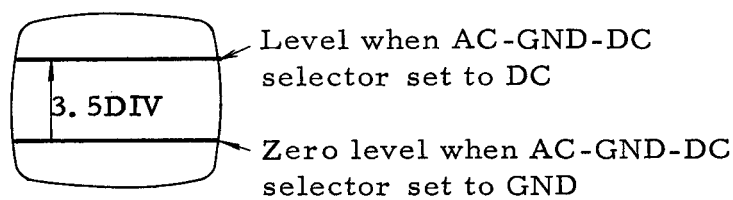


Fig. 2.5 Example of DC component voltage measurement

2.4.3 AC component voltage measurements

Fig. 2. 6 shows an example of an AC component voltage measurement.

VOLTS/DIV selector (12) ------ 0.2V/DIV

VARIABLE control (13) ------- CAL

With these settings, the measurement value is:

0.2V/DIV x 4.6DIV = 0.92Vp-p

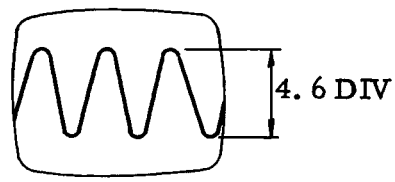


Fig. 2.6 Example of AC component voltage measurement

If the AC-GND-DC selector (8) is set at AC, the DC component in the input signal is blocked by the capacitor in the input circuit, and only the AC component is displayed on CRT. So it is possible to measure such a signal by enlarging as having a small-amplitude AC voltage which has been superimposed onto a high DC voltage.

2.4.4 Time measurements

It is possible to calculate the time, period and frequency of signals by observing their waveforms on the screen.
To read out the value of the time measurement illustrated in Fig.2.7 set the controls as follows:

TIME/DIV selector (15) ------- 1msec/DIV

VARIABLE control (17) ------- CAL, PUSH (X1)

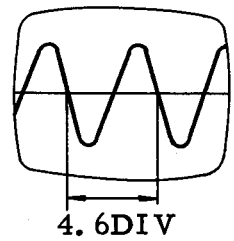


Fig. 2.7 Example of a time measurement

One period of the waveform on the screen is now equal to 4.6 DIV and so the time is:

1msec/DIV x 4.6 DIV = 4.6msec

Therefore, the time from A to B is 4.6msec and this is the value of one period of the signal. The frequency of this signal is calculated as follows:

$1/4.6\text{msec} = 1/4.6 \times 10^{3} = 220\text{Hz}$

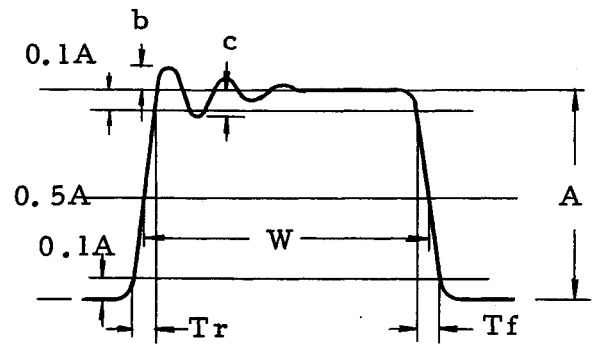
When the VARIABLE control (17) is pulled at CAL position, the time measurement in Fig. 2.7 is calculated as follows:

1msec/DIV x 4.6 DIV x 1/5 = 0.92msec

When the sweep has been magnified by 5 times, the measurement time is reduced to one-fifth of the value of time read out.

2.4.5 Observation of pulse waveforms

Terms used with square waves are shown in Fig. 2.8



A : Amplitude

$\frac{b}{A}$: Overshoot

$\frac{C}{A}$: Ringing

W : Pulse width

Tr : Rise time

Tf : Fall time

Fig. 2.8 Square wave waveforms

It is possible to measure the constants showing the characteristics of the pulse waveform in Fig. 2.8 using this oscilloscope in the following procedure.

1) Rise time measurement

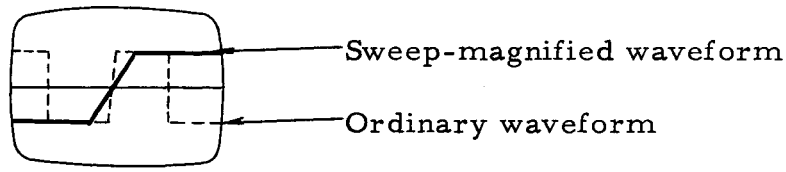
The rise time is the time required for the leading edge of a pulse to rise from 10% to 90% of its final value. An example of its measurement is given below.

With a pulse such as the one shown in Fig. 2.9 (1), the POSITION control (19) is adjusted so that the leading edge of the waveform to be observed is brought to the center of the screen.

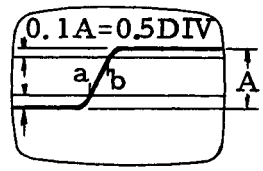
The VARIABLE control (17) is set to CAL (PULL X5) and pulled out to magnify the sweep.

When the fundamental amplitude is 5 DIV as is the case in Fig. 2.9 (2), the rise time is the time of the fundamental amplitude minus the vertical 0.5 DIV and so the first step is to measure $a = t_1$ in Fig. 2.9 (2) using the ↕ POSITION control (14). Next, $b = t_2$ is measured.

(1)



(2)



0.1A=0.5DIV

Fig. 2.9 Method of measuring the rise time

The rise time can be obtained from the following formula:

$$Tr = t_2(b) - t_1(a)$$

The square wave characteristics are calibrated by the VARIABLE control (13) set to CAL with 5 DIV amplitude, and so the way to conduct this measurement efficiently is to adjust the characteristics to as close to this state as possible using the VOLTS/DIV selector (12).

2) Fall time measurement

In order to measure the fall time, invert the SLOPE selector (21) and proceed in exactly the same way as for the rise time measurement.

3) Time difference measurement

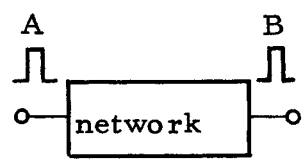


Fig. 2.10 Time difference measurement

When using dual trace function, it is possible to measure the time difference between the two phenomena, one of which is delayed by a certain time interval.
Connect input signal (A) in Fig. 2.10 to INPUT (CH1) connector and input signal (B) to INPUT (CH2) connector. Adjust the amplitude of the two signals on the screen so that they are equal, and read out the interval at a 50% amplitude. To observe pulse signals, take care of the following points.

(1) The pulse signal contains a great number of frequency components shorter than the pulse width or its period. Therefore, the same amount of attention must be paid when handling this signal as for high-frequency signals. (Use a coaxial cable or an optional probe to connect the pulse signal to the instrument, and use a short ground lead).

(2) In order to measure the rise time properly, it is also necessary to bear in mind that the rise time of this instrument is 35 nsec.
Where the rise time of the pulse to be measured is tr_1 and the rise time of the oscilloscope is tr_2, then the rise time to be observed can be calculated as:

$$T = \sqrt{tr_1^{\,2} + tr_2^{\,2}}$$

When observing a rising pulse of three times the oscilloscope rise time on this instrument (having a rise time of 35 nsec) the time to be observed on the screen will be :

$$T = \sqrt{35^2 + 105^2} \fallingdotseq 110\text{nsec}$$

This value indicates that there is an error of about 5% with regard to the correct value of 105nsec.

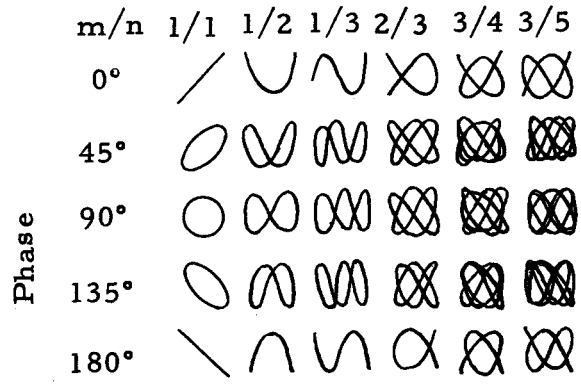
Generally, the following calculation must be performed when observing a pulse signal having a rise time of more than three times the oscilloscope rise time (tr2) :

Rise time of pulse to be measured $tr_1 = \sqrt{T^2 - tr_2^2}$

2.4.6 X-Y operation

This instrument is provided with an X-Y operation function where CH1 is used as X axis and CH2 as Y axis. Following the applications of measurement using this function.

1) Frequency measurement with Lissajous waveform



$$\frac{m}{n} = \frac{\text{X-axis signal frequency}}{\text{Y-axis signal frequency}}$$

Fig. 2.11 Lissajous waveform and frequency ratios

Set the instrument to X-Y operation (see 2.3.8.) and connect a signal of known frequency to the X axis and a signal of unknown frequency to the Y axis. Lissajous waveforms are displayed on the CRT by the frequency ratio and phase difference. Observe the waveforms, and the unknown frequency can be measured.

Example: Y axis, (7) INPUT (CH1) connector .... signal of known frequency fy = 440Hz

X axis, (7) INPUT (CH2) connector .... signal of unknown frequency fx = ?

When such a Lissajous waveform is displayed as having a 90° phase difference and an m/n frequency ratio of 2/3, then the unknown frequency fy can be determined as follows:

fx = (m/n) fy = 2/3 440Hz 293Hz

If the frequency ratio of the two signals is not an integer, shift the known frequency so that the unknown frequency can be measured.

2) Phase difference measurement with Lissajous waveforms

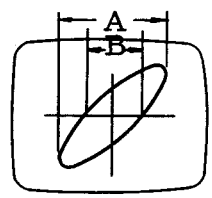


Fig. 2.12 Phase difference measurement

The phase difference of two signals can be measured as follows.

Connect each of the two signals to the X axis and Y axis respectively. Measure the amplitude of each, A and B (refer to Fig. 2.12) and then determine the phase difference (θ).

$\sin \theta = B/A \qquad \theta = \sin^{-1} B/A$

In this case, the phase difference is calculated across a 0-90° range though in practice it is thought of as a 0-360° range. Therefore, refer to the case where m/n is equal to 1/1 in Fig. 2.11, and compensate for the phase difference.

2.4.7 TV signal observation

This instrument is provided with the following functions for observing TV signals:

- **TV-V** sweep circuit (approx. 2ms/DIV) } for observing vertical video signals
- **sync** separation circuit with CR filter } for observing vertical video signals
- **TV-H sweep circuit (10 μsec/DIV range)** } for observing horizontal sync signals

1) Observation of vertical video signals

TIME/DIV selector (15) --- TV-V

MODE selector (18) ----- TV-V

VARIABLE control (17) --- CAL

With these settings it is possible to observe one field of vertical video signal. Signals can be triggered by either an internal or an external signal source when the trigger mode is set to NORM.
Set the MODE selector (18) to AUTO to observe the state of the waveforms when signals are applied.

2) Observation of horizontal sync signals

TIME/DIV selector (15) --- 10 μs/DIV

VARIABLE control (17) --- CAL

With above settings, one frame of horizontal sync signal can be observed.
The sync signal is the same as video signal and so triggering operation for one frame is performed by adjusting the LEVEL control (22) finely.

Section 3 MAINTENANCE & SIMPLIFIED CALIBRATION

3.1 Preventive Maintenance

3.1.1 Cleaning

(1) Clean the panel and the outside of the case with cloth dampened with diluted neutral detergent or alcohol, then with a dry cloth. Do not use organic solvents such as benzine or thinner.

(2) Clean the cabinet interior of dust with a dry brush, compressed air from a compressor or exhaust of a vacuum cleaner.

3.1.2 Cathode-ray Tube Handling

(1) Since this oscilloscope is not equipped with any light filter to allow better observation, use care when handling the CRT. Avoid striking its screen with any hard object and exerting strong force on the screen. Otherwise it may cause scratches on the screen or damage of CRT.

(2) After removing the dust of the CRT screen, be sure to wipe it with a dry soft cloth.

3.1.3 Probe Compensation

(1) Before measurement, probe must be compensated for adjusting the input capacitance. (See page 2-15, 2-16)

3.2 Simplified Calibration

Use of the .5V CALIBRATOR terminal (6) allows calibration of vertical gain and time base.

NOTE Calibration must be made at exactly rated AC line voltage.

3.2.1 Vertical gain

(1) Set the CH1 and CH2 VARIABLE control knob (13) to the CAL position, and VOLTS/DIV switch (12) to the 0.1 V/DIV position.

(2) Adjust the "GAIN ADJ" screwdriver-adjusted resistor (R155, 255 at the bottom plate: See page 5-4) so that the observed CAL waveform becomes 5 DIV in amplitude, since the output of the CAL terminal is 0.5 Vp-p.

3.2.2 Time base

(1) Connect the CH1 connector to the .5V CALIBRATOR (CAL) terminal (6), and set the VARIABLE control (17) to the CAL position. Trigger a sweep and observe the period of the CAL signal.

(2) Adjust the "X1 GAIN" screwdriver-adjusted resistor (R395: See page 5-7) on the [O]H BOARD so that the observed CAL signal period becomes equal to the period of the power supply voltage.

(3) Pull the VARIABLE control knob (17), and adjust the "X5 GAIN" screwdriver-adjusted resistor (R392: See page 5-7) on the [O]H BOARD so that the observed CAL signal period magnified to 5 times.

Section 4. ADJUSTMENTS

4.1 Preliminary Adjustments

4.1.1 Power Supply Voltage Check

Set each control on front panel as follows before check.

POWER:	OFF
INTENSITY:	Counterclockwise
FOCUS:	Middle
LEVEL:	Middle
SOURCE:	INT
SLOPE:	+
MODE(Horizontal):	AUTO
H POSITION:	Middle
VARIABLE(Horizontal):	CAL
TIME/DIV:	1msec/DIV
V POSITION:	Middle
VARIABLE(CH1, CH2):	CAL
VOLT/DIV:	10mV/DIV
AC-GND-DC:	GND
MODE(Vertical):	CH1

Required test equipment

- AC voltmeter
- Variable voltage transformer
- Oscilloscope with a vertical deflection sensitivity of 5 mV/DIV or more
- High-voltage probe (1000:1)

CHECK POINT LOCATION	CHECK POINT	DC VOLTAGE LEVEL At AC LINE NOMINAL VOLTAGE	DC ⊿V When AC LINE VARIES ±10%
[F] VH OUT BOARD (See page 5-5)	J506-92 +15V	+14.05 ~ +15.55V Ripple = 20mVp-p max.	⊿V = 0.6V or less
	J506-87 -15V	-16.35 ~ -14.85V Ripple = 20mVp-p max.	⊿V = 0.6V or less
	J506-84 230V	+218.5 ~ +241.5V Ripple = 2Vp-p max.	
[R] POWER BOARD (See page 5-8)	117	-1350 ~ -1650V	

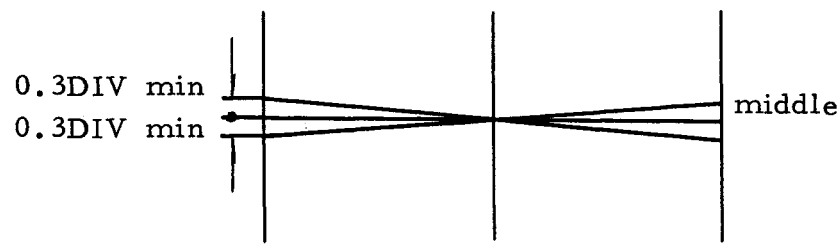
⊿V = Variation between nominal DC voltage and measured voltage.

4.1.2 Trace ROTATION Adjustment

Required test equipment: None

Preparation: Set the INTEN and FOCUS knobs to optimum point and the AC-GND-DC knob to GND.

Procedure: Check that the trace can be adjusted over the range shown below by rotating the ROTATION control on the front panel; then set it to the center of the vertical scale.



4.1.3 ASTIG Adjustment

Required test equipment: Time marker generator

Preparation: Set the AC-GND-DC switch to DC and the TIME/DIV switch to 1 mS/DIV, and apply a marker signal of 1 mS. Set STABILITY (R376, [O] H BOARD See page 5-7) at the position just before the sweep starts free-running, to allow triggering.

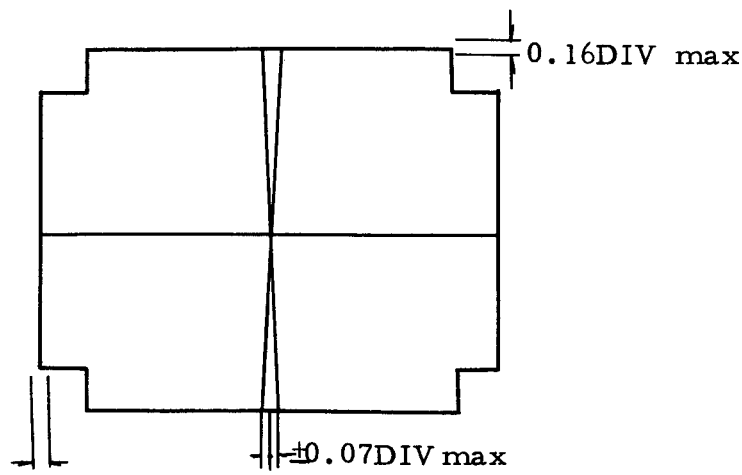
Procedure: Set the ASTIG (R556, [Q] CRT SOCKET BOARD See page 5-7) control for the best spot or trace adjusting the FOCUS control at the same time.

4.1.4 Check of CRT Distortion

Required test equipment: Same as paragraph 4.1.3.

Preparation: Same as paragraph 4.1.3.

Procedure: (a) Check on peripheral distortion
Set a time marker signal so that it coincides with the graticule of the CRT, and make sure that the signal remains between the limit, vertically and horizontally, shown below.



(Angle of axis: 1° or less)

(b) Check on angle of axis.
Set the time marker signal so that it coincides with the graticule of the CRT and position the trace at the center of the graticule. Make certain that perpendicularity is 1° or less (within ±0.07 DIV at the end of the graticule as shown in the fig.

(c) Move the base-line of the time marker signal up and down with the V POSITION control and make certain the effective area of the CRT covers the screen scale framing area.

4.2 Vertical Circuit Adjustments

4.2.1 STEP ATT BAL & VARIABLE BAL Adjustment

Preparation: Set the AC-GND-DC switch to GND and allow the sweep generator to free run. Then, rotate V POSITION control to place the trace at the screen center. (Both channels)

Procedure:
(a) Set the V MODE switch to CH1 and set the VOLTS/DIV knob of CH1 to 10 mV/DIV. With the STEP ATT BAL screwdriver, bring the trace to the center of the screen and make fine adjustments until the trace does not move when VOLTS/DIV knob is changed to 20 mV/DIV and 50 mV/DIV.

(b) Repeat the same adjustment (a) for channel 2(CH2).

(c) Setting the VOLTS/DIV knob of CH1 to 50 mV/DIV, adjust the screwdriver adjustment VARI BAL(R149 [C] V BOARD See page 5-4) until there is no trace movement when the VARIABLE knob of CH1 is

turned back and forth.

(d) Follow the same adjustment by adjusting the VARI BAL (R249 [C] V BOARD See page 5-4) for CH2.

4.2.2 GAIN Adjustment & ATT Check

Required test equipment: Voltage calibrator

Preparation: Set the VOLTS/DIV selectors of both channels to 10 mV/DIV, and set the calibrator output to 50 mV. Rotate the VARIABLE control to the CAL positions, and set the TIME/DIV selector to 1 mS/DIV, then trigger the sweep.

Procedure:

(a) Adjust GAIN ADJ (R155, [C] V BOARD See page 5-4) so that a square wave of 5 DIV may appear on the screen.

(b) Make sure that the amplitude of the square wave on the screen becomes 1.9 divisions or less when the VARIABLE control is rotated to the fully counterclockwise position.

(c) Apply corresponding calibrator output signals to the settings of VOLTS/DIV, and check to see if sensitivity accuracy is within $\pm 4\%$.

(d) Follow the same adjustment and check using the VARI BAL (R255, [C] V BOARD for CH2 See page 5-4).

4.2.3 Vertical POSITION Control, Ripple and Noise (CH1 and CH2)

Required test equipment: Voltage calibrator

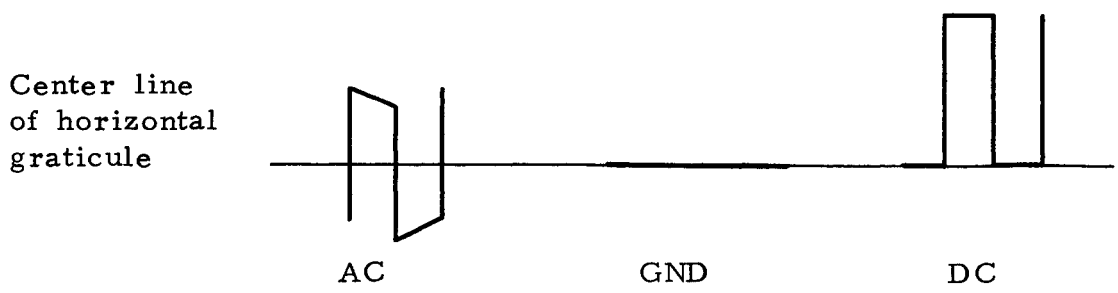
Preparations: Set VOLTS/DIV to 10 mV/DIV, TIME/DIV to 1 mSec/DIV and apply a positive polarity calibrator signal 50 mVp-p.

Procedure:

(a) Set AC-GND-DC to AC, and by turning the V POSITION knob clockwise and counter-clockwise, make certain the waveform will disappear from the screen. At the same time, make certain that by turning the knob CW, the trace moves toward the top of the screen. (both channels)

(b) Make sure that the waveforms shown below are observed when the AC-GND-DC switch is set to the AC, GND or DC position respectively. (both channels)

(c) Removing the calibrator signal, ascertain that the trace movement due the grid current (Ig) when moving the AC-GND-DC knob from GND to AC or DC is within 0.2 DIV. At the same time, make certain the ripple and noise in the trace is within 0.1 DIV when set to GND.



4.2.4 Vertical MODE Switch

Required test equipment: Voltage calibrator

Preparations: Same as item 4.2.2, however, the signal is connected to CH1.

Procedure: (a) Set the V MODE switch to DUAL and make certain dual trace operation.

4.2.5 ALT-CHOP operations

Required test equipment: None

Preparations: Set the V MODE switch on DUAL, and the TIME/DIV knob to .1 mS/DIV.

Procedure: (a) ALT

Set the V INPUT to GND, and the sweep MODE switch to NORM, and by turning the LEVEL switch back and forth, ascertain that the sweep in CH1 and CH2 is performed alternately.

(b) CHOP

Set the TIME/DIV switch to 1 mS/DIV, and by turning the LEVEL knob back and forth, ascertain that the trace in CH1 and CH2 is simultaneously displayed.

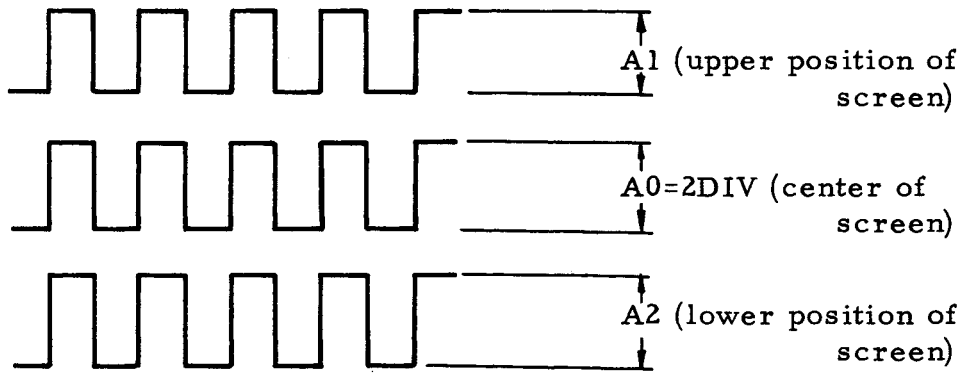
4.2.6 Linearity Check

Required test equipment: Voltage calibrator

Preparation: Set the VOLTS/DIV and the TIME/DIV respectively to 10 mV/DIV and 1 mS/DIV, and apply an output signal of 50 mV from the calibrator.

Then, adjust the VARIABLE control for the amplitude of 2 divisions at the center of the screen. (CH1 only)

Procedure: Measure the change of the squarewave amplitude on the graticule when the squarewave is shifted vertically with the V POSITION control, and make sure the amplitude remains in the range of 2 DIV ±0.15 DIV or less.



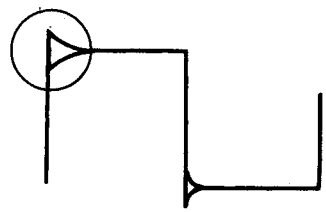
A0=2 DIV $\quad 1.85 \leqq A1, A2 \leqq 2.15$ DIV

4.2.7 Attenuator Adjustment

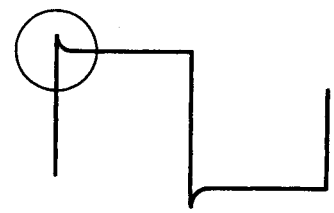
Required test equipment: Square wave oscillator and oscilloscope probe (VQ-054K)

Preparation: Set the VOLTS/DIV selector to the 10 mV/DIV position. Connect a 1 kHz, 0.5 Vp-p squarewave signal from the squarewave oscillator to the oscilloscope under test through a VQ-054K series 10:1 probe. The squarewave of 1 kHz, 5 divisions will appear on the screen. Then, set the AC-GND-DC to DC, and adjust the capacitance of the probe for a flat square waveform. (both channels)

Procedure: Set the VOLTS/DIV to 0.2 V/DIV, and adjust the C102, 103 and C202, 203 (A CH1 ATT, B CH2 ATT See page 5-4) shown in the below figure. Then, set the VOLTS/DIV to 2 V/DIV, and adjust the C106, 109 and 206, 209 (A CH1 ATT, B CH2 ATT See page 5-4) shown below.



Input capacitance adjustment
0.2V/DIV --- C102, 202
2 V/DIV --- C106, 206



Fast-component adjustment
0.2V/DIV --- C103, 203
2 V/DIV --- C109, 209

4.2.8 Squarewave Response Adjustment

Required test equipment: The same as in item 2.7.

Preparations: Set the VOLTS/DIV knob to 10 mV/DIV, and apply a 50 mVp-p, 100 kHz square wave. (both channels)

Procedure: Adjust C120 (CH1) and C220 (CH2) (C V BOARD See page 5-4) to the point where squarewave overshoot is 0%.

4.2.9 Frequency Characteristics

Required test equipment: Constant amplitude sinewave generator.

Preparations: Using the 50 kHz sinewave as a reference, measure the frequency characteristics in 10 mV/DIV. This should be done in both CH1 and CH2 with the VARIABLE knob set to the CAL position and at a reference amplitude of 6 DIV.

Procedure: Set VOLTS/DIV switch to 10 mV, and apply a 50 kHz sinewave signal with a display amplitude of 6 divisions from the sinewave generator. Change the frequency to 10 MHz keeping output voltage constant. Make sure the display amplitude is 4.2 divisions or more.

4.2.10 CAL Output Adjustment

Required test equipment: An oscilloscope calibrated to within ±1% in the 0.1V/DIV range.

Preparations: Connect the calibrated oscilloscope to the CAL terminal.

Procedure: With a screwdriver, adjust R517 CAL ADJ (R POWER BOARD See page 5-8) to the point where the CAL terminal signal is 0.5 Vp-p.

Check: Make sure the duty cycle of the CAL waveform is 45 to 55%.

4.2.11 Crosstalk

Required test equipment: 50 kHz 10 Vp-p sinewave generator.

Preparations: Connect the 50 kHz 10 Vp-p sinewave to CH1, and set the VOLTS/DIV knob to 5 V/DIV.

Procedure: (a) Setting the VOLTS/DIV knob of CH2 to 10 mV/DIV, AC-GND-DC to AC, and the V MODE switch to DUAL, make certain that the leak of the signal applied to CH1 is over 70 dB (less than 0.3 DIV on the screen).

(b) Applying the same signal to CH2, check the leakage from CH2 to CH1.

(c) Connecting the CAL signal to CH1 INPUT, and setting the VOLTS/DIV knob to 0.1 V/DIV in CH1 and 10 mV/DIV in CH2, make certain the leaked signal from CH1 to CH2 is within 0.2 DIV or less. (The AC-GND-DC switch should be placed on AC for both channels.)

(d) Connecting the CAL signal to CH2 INPUT, perform the same check on the leakage from CH2 to CH1.

4.2.12 Input Resistance

Required test equipment: Resistance meter

Preparations: Set the VOLTS/DIV knob to 10 mV/DIV for both CH1 and CH2.

Procedure: Make certain the input resistance between 10 mV/DIV and 5 V/DIV is within ±3% of 1 MΩ.

4.3 Horizontal Circuit Adjustments

4.3.1 Time Base

Required test equipment: Time marker

Preparations: Set the TIME/DIV knob to 1 mS/DIV, set the time base VARIABLE to the CAL position and connect the 1 mS time marker signal.

Procedure: (a) With a screwdriver, adjust X1 GAIN (R395 [O]H BOARD See page 5-7) so that the markers of 1 mSec correspond with the vertical scales.

(b) Next setting the knob to 1 μ/DIV and adjust (C327) 1 marker/DIV with a 1 μS time marker signal.

(c) Set the time marker signal to 0.1 mS, and the TIME/DIV knob to 1 mS/DIV. Setting the time base VARIABLE knob to PULL, in a X5 MAG state, adjust X5 GAIN (R392 [O] H BOARD See page 5-7) with a screwdriver until sweep speed is 0.2 mS/DIV.

(d) Make certain all ranges are within the tolerance listed in the table below.

RANGE S/DIV	NORM (x1) TOLERANCE	MAG (x5) TOLERANCE
0.5μ	±5%	±7%
1μ	Adjusting Point	+7%
2μ	±5%	
5μ	±5%	
10μ	±5%	±7%
20μ	±5%	
50μ	±5%	
0.1m	±5%	
0.2m	±5%	
0.5m	±5%	
1m	Adjusting Point (R395)	Adjusting Point (R392)
2m	±5%	
5m	±5%	
10m	±5%	
20m	±5%	
50m	±5%	
0.1	±5%	

4.3.2 Sweep Length and VARIABLE

Required test equipment: Time marker

Preparations: Set the TIME/DIV knob to 1 mS/DIV and observe the 1 mS time marker signal.

Procedure:

(a) Make certain the sweep length is 12 to 15 DIV in length.

(b) Set the time marker signal to 0.1 S and turn the time base VARIABLE knob all the way CCW. Matching the sweep start point to left-most graticle of the CRT, make certain the second pulse falls within 8 divisions. Stable state will be obtained when the H MODE is in the NORM position.

(c) With the VARIABLE knob, adjust the second pulse to match up with the right-most graticle of the CRT. Turning the POSITION knob all the way CW and CCW, make certain the pulse moves right and left respectively and exceeds 5 divisions.

4.3.3 X-Y Operation

Required test equipment: Amplitude calibrator and sine wave generator.

Preparations: Connect the 50 mVp-p amplitude calibrator to the CH1 (X) INPUT. Place the AC-GND-DC switch to DC and set the VOLTS/DIV knob to 10 mV/DIV.

Procedure: In X-Y operation, turn the screwdriver adjustment R171 (C V BOARD See page 5-4) to the point where the calibration signal amplitude covers

5 DIV in the X direction.

Checks:

(a) Set the output of the sinewave generator to 60 mVp-p, and with a T-branch, apply it simultaneously to the INPUT of CH1 and CH2. At a frequency of 10 kHz, make certain the phase difference is within 3°.

(b) Set the AC-GND-DC switch of CH2 (Y) to GND, and measure the frequency characteristics of CH1 (X). This reading should be in excess of 500 kHz -3 dB. (Reference signal; 1 kHz, 6 DIV)

4.3.4 Stability Adjustment

Required test equipment: None

Preparations: Set the horizontal MODE switch to NORM, and turn the LEVEL adjustment fully CCW. Then connect JP3 (OH BOARD See page 5-7) which has been cut.

Adjustment: Turn the STABILITY screwdriver adjustment R376 (OH BOARD See page 5-7) from its counterclockwise position slowly in the clockwise direction and set it at the point where the sweep commences free run. Cut off JP3 (OH BOARD See page 5-7) and make certain that free run stops.

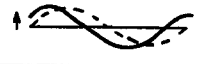
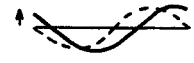
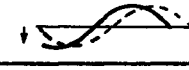
4.3.5 Triggering (TRIG) SLOPE and LEVEL

Required test equipment: Sinewave generator.

Preparations: Set the LEVEL adjustment roughly to the middle position, and apply the 50 kHz 4 Vp-p sinewave signal to the CH1 input. Set the VOLTS/DIV switch to 1 V/DIV.

Checks:

(a) When the SLOPE switch is changed alternately from (+) to (-), make certain it corresponds with table below. At the same time, make certain that when the sweep MODE switch is on NORM, the trace disappears when stability breaks down, and that in AUTO, freerun occurs.

LEVEL	SLOPE (+)	SLOPE (-)
		
		

(b) Setting the CH1 VOLTS/DIV switch to 0.5 V/DIV, adjust V POSITION to where the signal comes within the effective area of the CRT.
Make certain that by turning LEVEL back and forth, stability breaks down on both sides of the screen.

(c) Changing the vertical MODE switch from CH1 to DUAL, perform the same check.

(d) Branch the CH1 signal and connect it to the EXT TRG terminal. Setting the SOURCE switch to EXT, perform the check in the underlined portion of step (b) above.

(e) Setting the SOURCE switch to LINE, perform the check in the underlined portion of step (b) above.

4.3.6 Trigger Sensitivity & Trigger Range

Required test equipment: Low frequency sinewave oscillator

Procedure: Check that the waveform can be triggered with the following specifications.

SOURCE	V MODE	H MODE	TRIG. SENSITIVITY	Triggering range	DATA
INT	CH1	AUTO	0.4DIV	50 ~ 2MHz	
		NORM	0.4DIV	30 ~ 2MHz	
			1.5DIV	~ 10MHz	
		TV-V	1DIV	(TV-V SYNC LEVEL)	
	DUAL	AUTO	0.4DIV	50 ~ 2MHz	
		NORM	0.4DIV	30 ~ 2MHz	
			1.5DIV	~ 10MHz	
		TV-V	1.0DIV	(TV-V SYNC LEVEL)	
EXT		AUTO	0.2Vp-p	50 ~ 2MHz	
		NORM	0.2Vp-p	30 ~ 2MHz	
			0.75Vp-p	~ 10MHz	
		TV-V	0.5Vp-p	(TV-V SYNC LEVEL)	

4.4 Calibrator Output Voltage

Required test equipment: Oscilloscope with calibrated vertical gain within 1% or less at the 0.1 V/DIV sensitivity.

Procedure: Connect the CAL terminal ⑥ to the calibrated oscilloscope, and adjust the CAL ADJ resistor (R517 [R] POWER BOARD See page 5-8) until the observed calibrator output voltage will be 0.5 Vp-p on the screen.

Section 5. SERVICE INFORMATION

5.1 Troubleshooting

Preparation: Set each control on the front panel as follows in fig 5-1 before troubleshooting using next chart, and apply a CALIBRATOR signal to the CH1 INPUT connector.

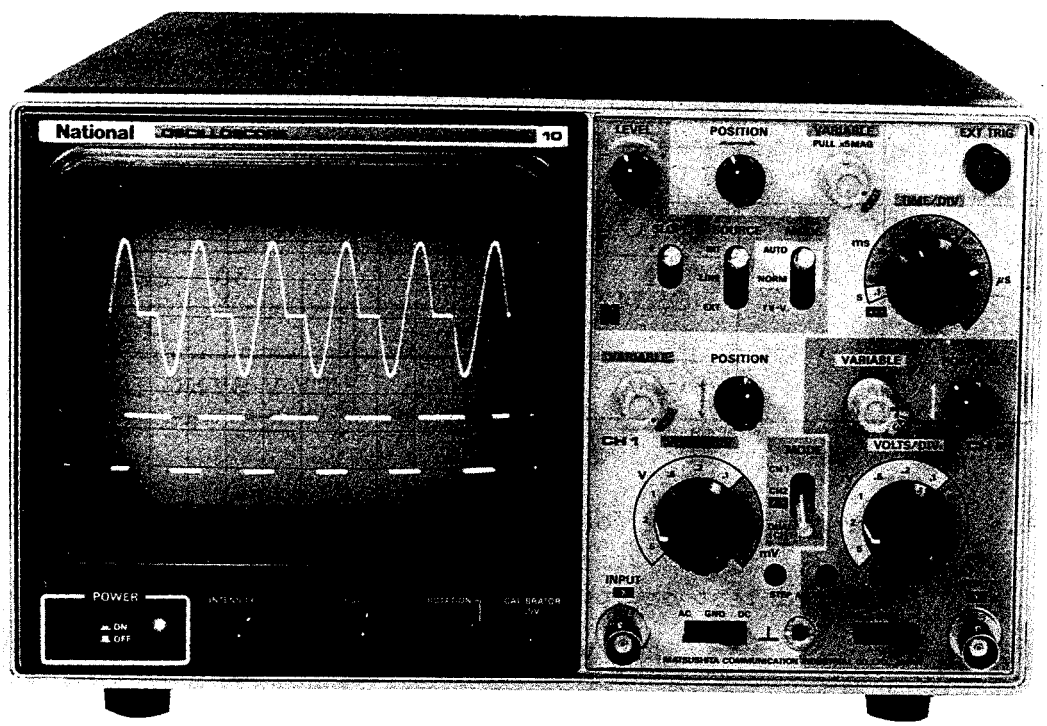
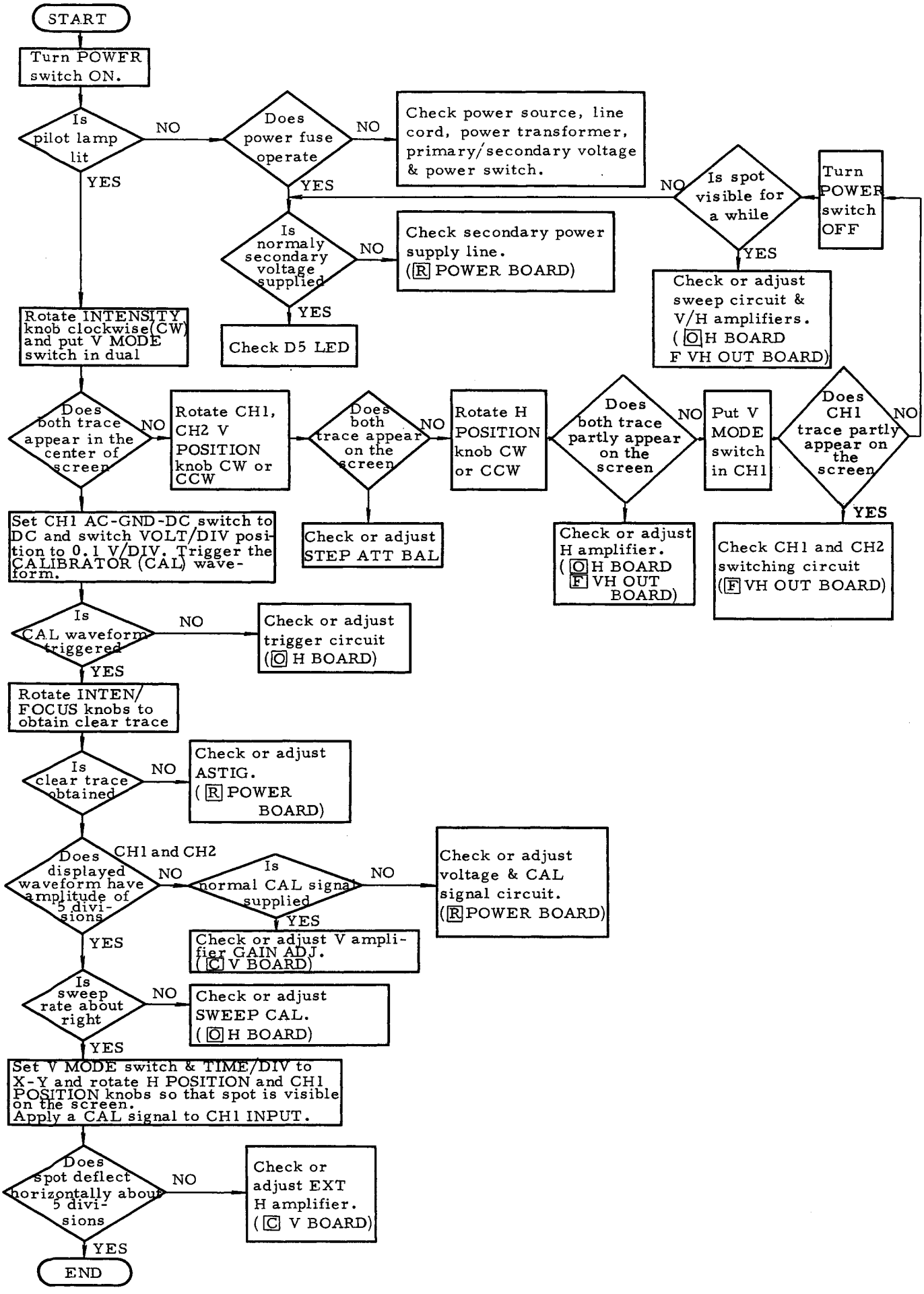
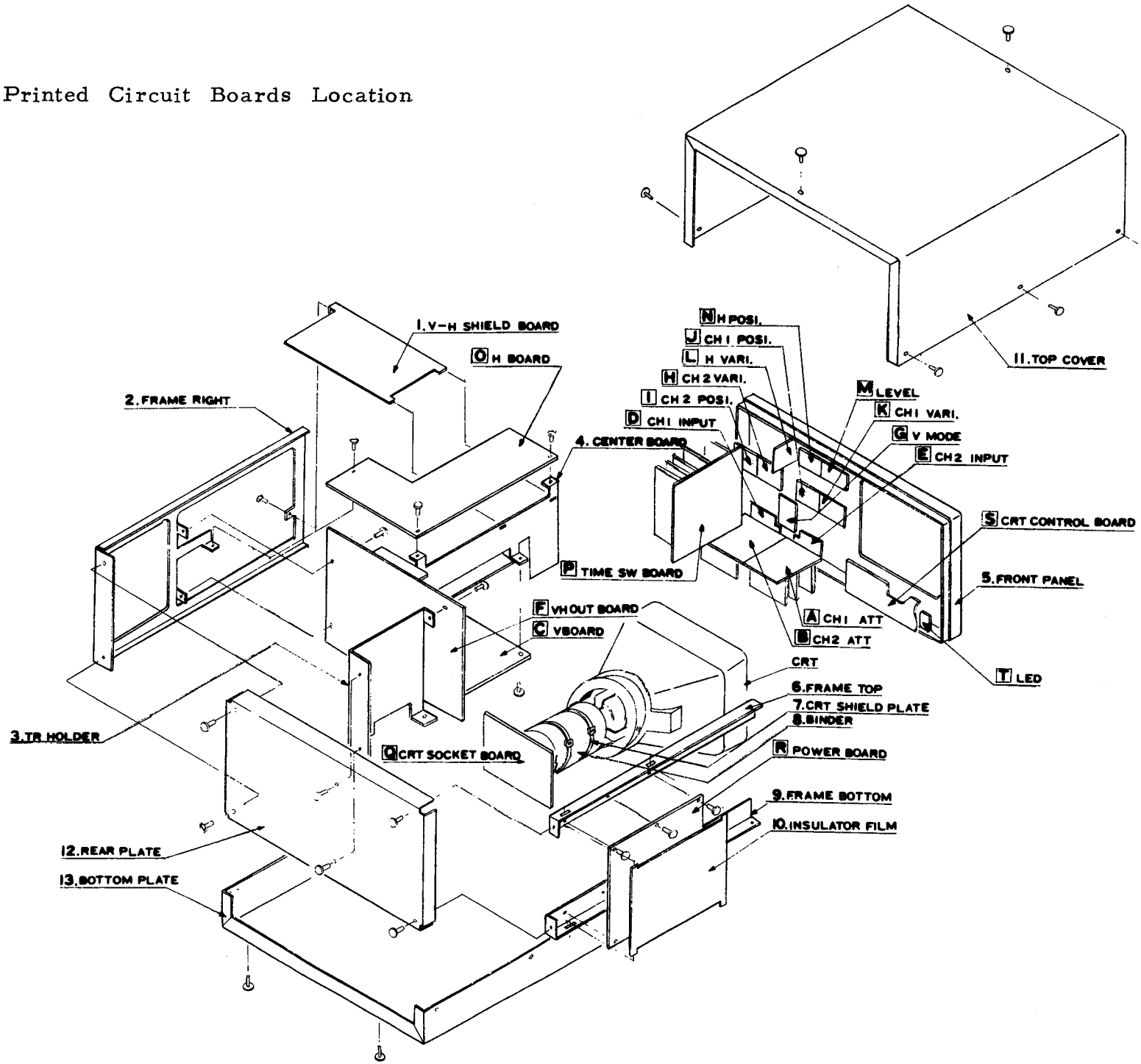


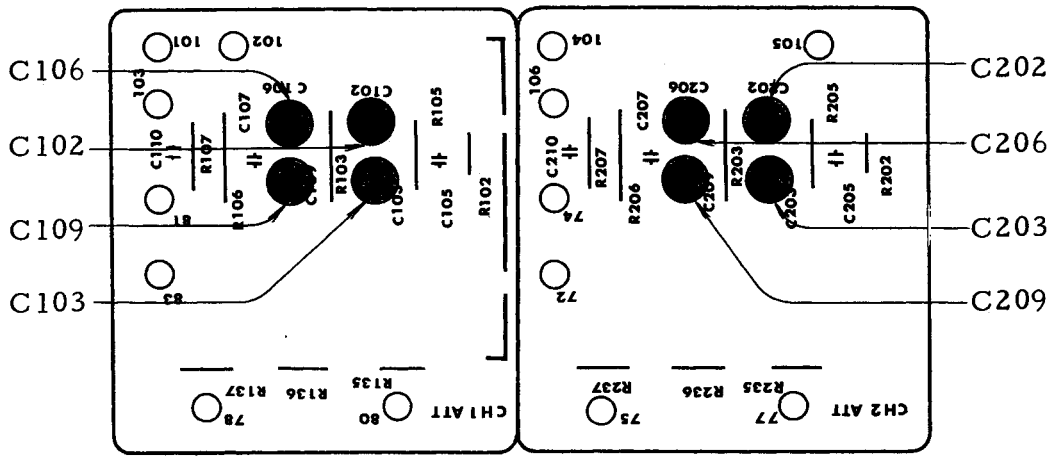
fig 5-1 Panel control for troubleshooting


START
Turn POWER switch ON.
Is pilot lamp lit
NO
YES
Does power fuse operate
NO
Check power source, line cord, power transformer, primary/secondary voltage & power switch.
YES
Is spot visible for a while
NO
Turn POWER switch OFF
YES
Is normaly secondary voltage supplied
NO
Check secondary power supply line. (R POWER BOARD)
YES
Check D5 LED
Check or adjust sweep circuit & V/H amplifiers. (O H BOARD F VH OUT BOARD)
Rotate INTENSITY knob clockwise(CW) and put V MODE switch in dual
Does both trace appear in the center of screen
NO
Rotate CH1, CH2 V POSITION knob CW or CCW
Does both trace appear on the screen
NO
Rotate H POSITION knob CW or CCW
Does both trace partly appear on the screen
NO
Put V MODE switch in CH1
Does CH1 trace partly appear on the screen
NO
YES
Set CH1 AC-GND-DC switch to DC and switch VOLT/DIV position to 0.1 V/DIV. Trigger the CALIBRATOR (CAL) waveform.
Check or adjust STEP ATT BAL
Check or adjust H amplifier. (O H BOARD F VH OUT BOARD)
Check CH1 and CH2 switching circuit (F VH OUT BOARD)
Is CAL waveform triggered
NO
Check or adjust trigger circuit (O H BOARD)
YES
Rotate INTEN/ FOCUS knobs to obtain clear trace
Is clear trace obtained
NO
Check or adjust ASTIG. (R POWER BOARD)
Does CH1 and CH2 displayed waveform have amplitude of 5 divisions
NO
Is normal CAL signal supplied
NO
Check or adjust voltage & CAL signal circuit. (R POWER BOARD)
YES
Check or adjust V amplifier GAIN ADJ. (C V BOARD)
YES
Is sweep rate about right
NO
Check or adjust SWEEP CAL. (O H BOARD)
YES
Set V MODE switch & TIME/DIV to X-Y and rotate H POSITION and CH1 POSITION knobs so that spot is visible on the screen. Apply a CAL signal to CH1 INPUT.
Does spot deflect horizontally about 5 divisions
NO
Check or adjust EXT H amplifier. (C V BOARD)
YES
END

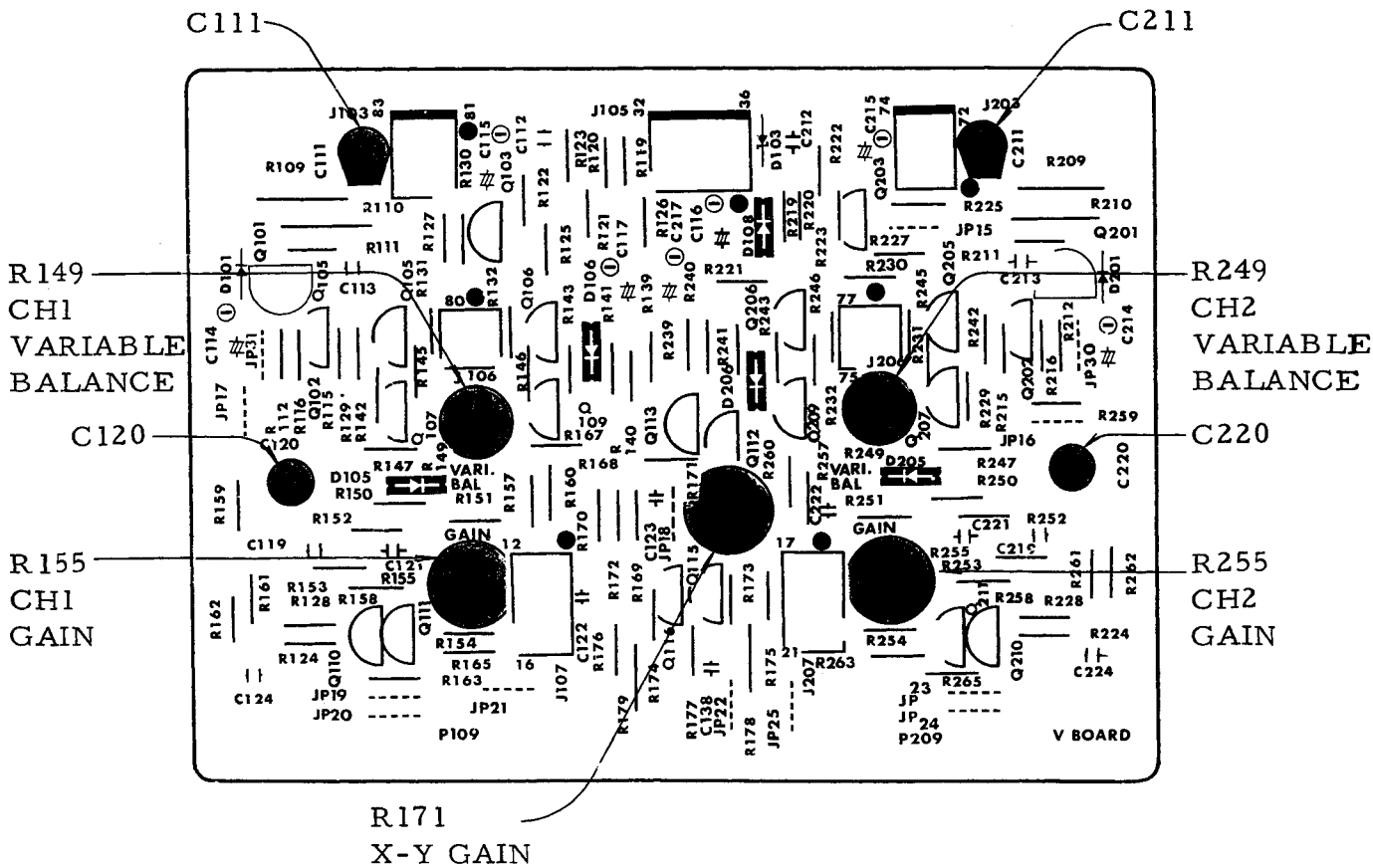
5.2 Printed Circuit Boards Location



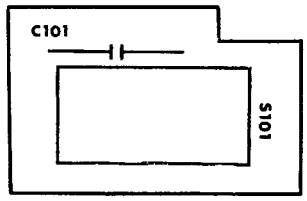
5.3 Printed Circuit Boards



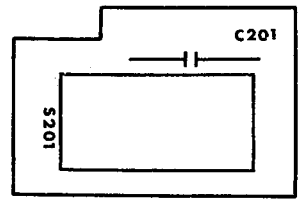
A CH1 ATT B CH2 ATT



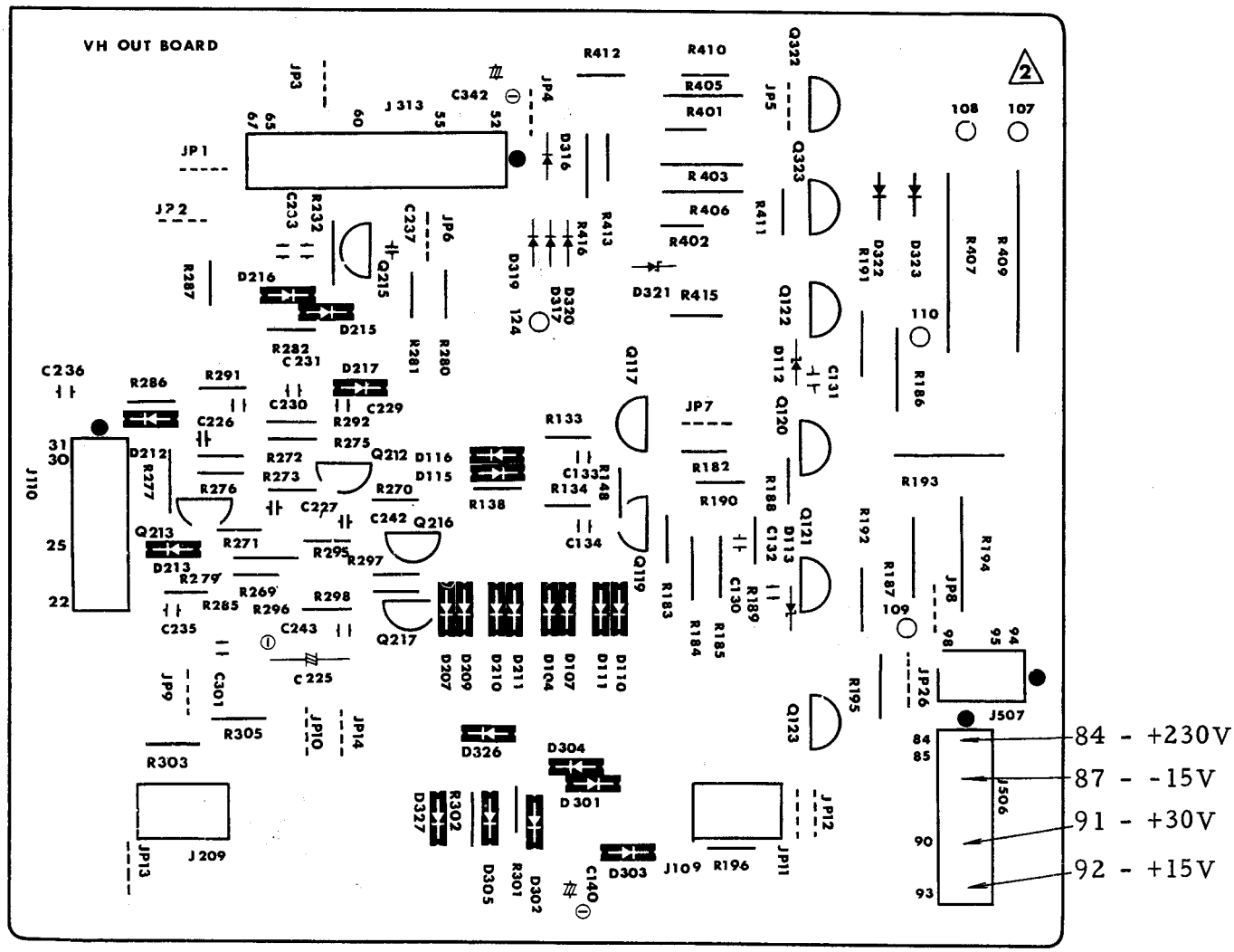
C V BOARD



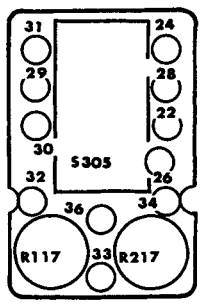
D CH1 INPUT



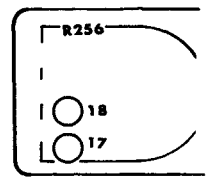
E CH2 INPUT



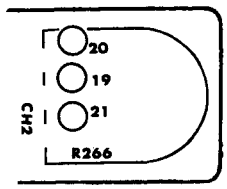
F VH OUT BOARD



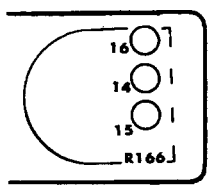
G V MODE



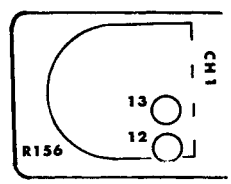
H CH2 VARI.



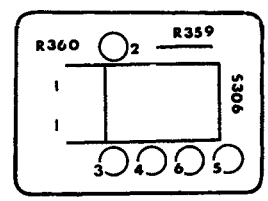
I CH2 POSI.



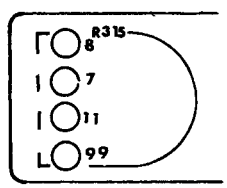
J CH1 POSI.



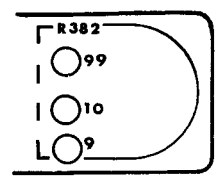
K CH1 VARI.



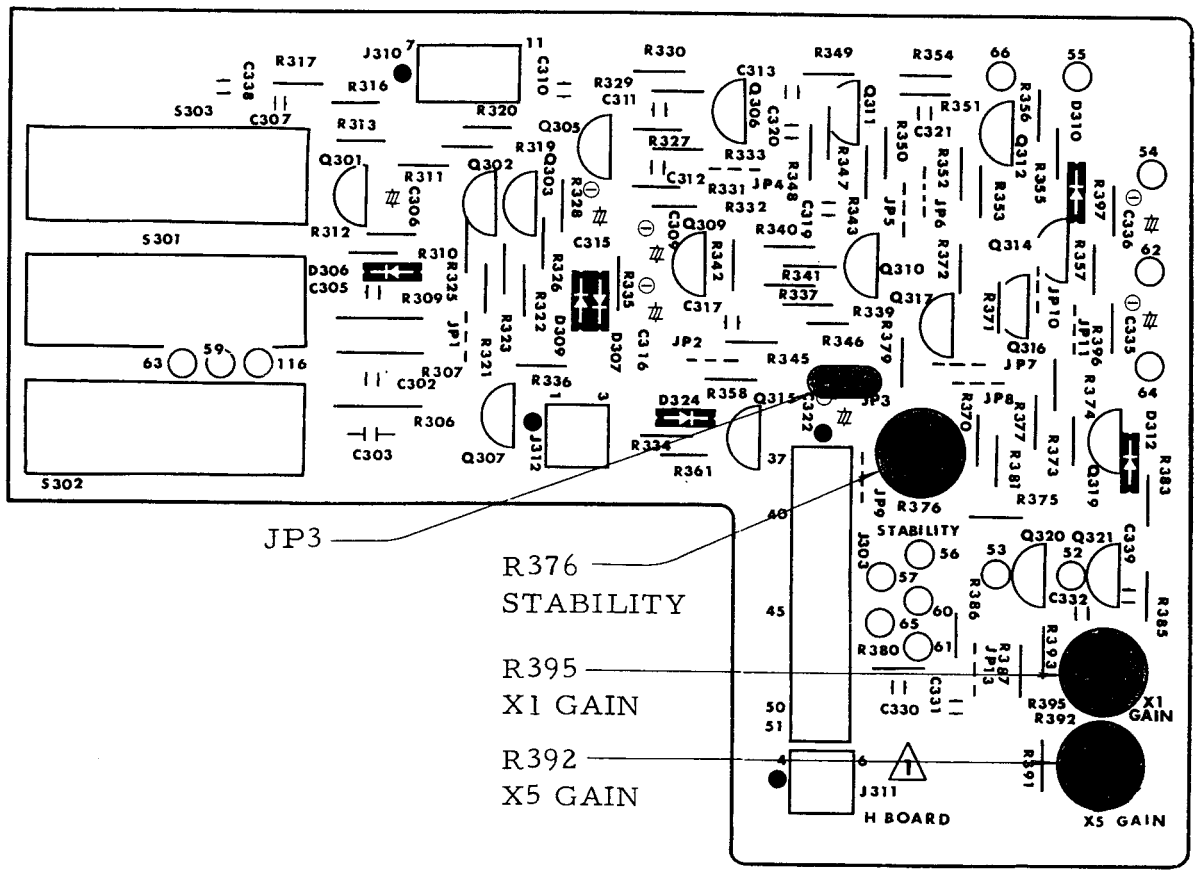
L H VARI.



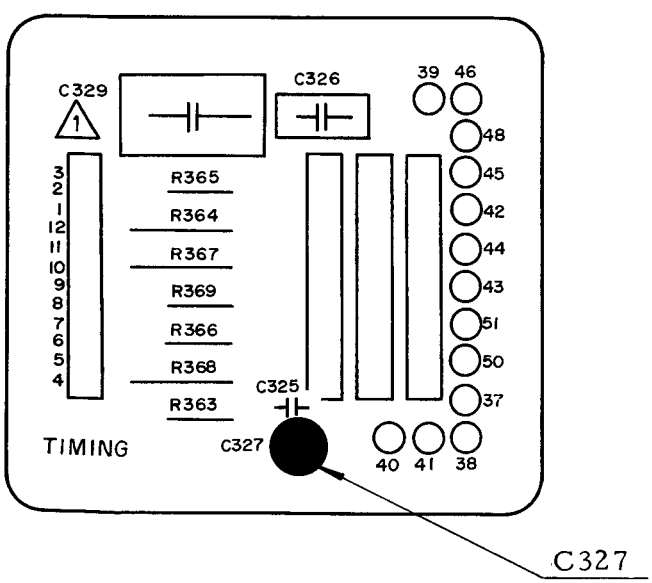
M LEVEL



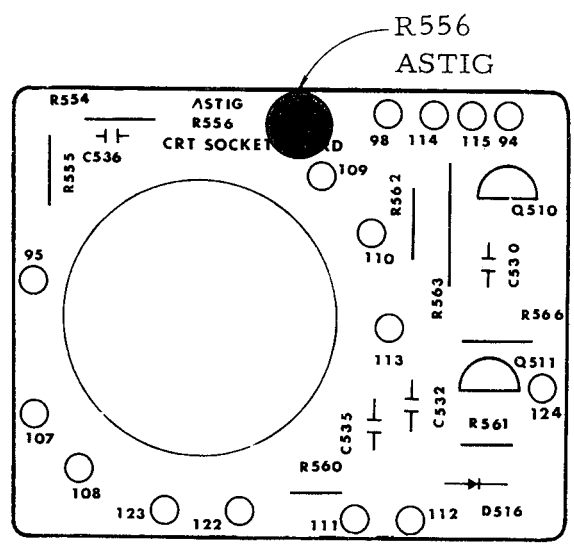
N H POSI.



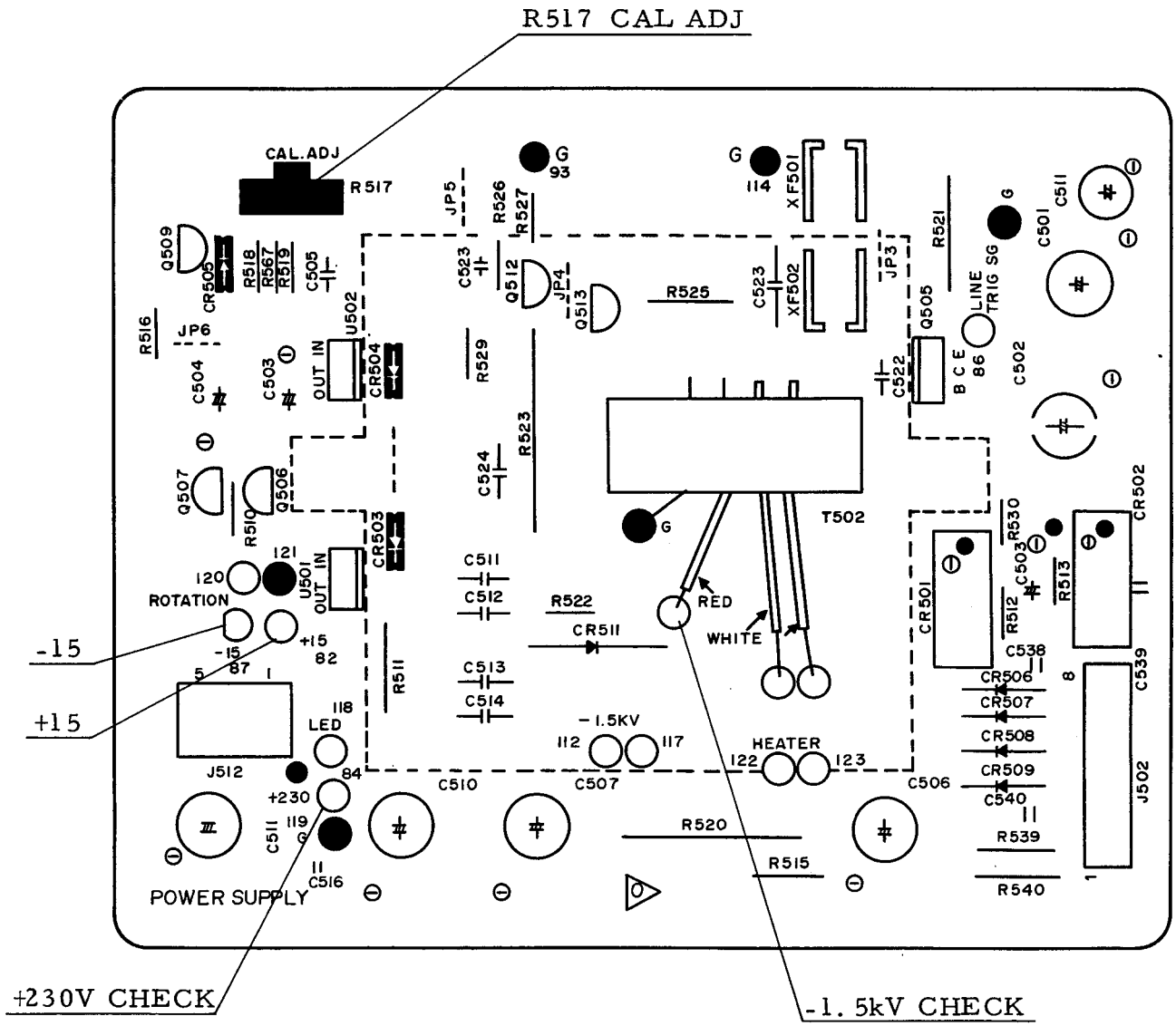
O H BOARD



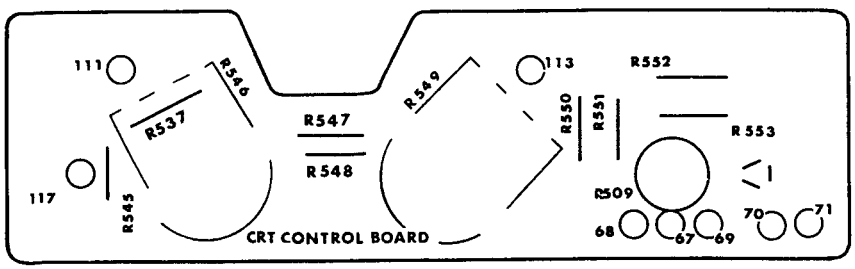
P TIME SW BOARD



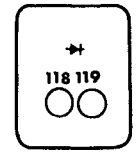
Q CRT SOCKET BOARD



R POWER BOARD



S CRT CONTROL BOARD



T LED

P A R T S L I S T

CRT NO.	MFR. PART NO.	DISCRIPTION		
		CAPACITOR		
C 101	YC@MD12J473M	0.047UF	630V	PLASTIC
C 102	ECV1ZW20X53D	20PF	TRIMMER	CERAMIC
C 103	ECV1ZW04X53D	4PF	TRIMMER	CERAMIC
C 105	ECCW2H150F	15PF	500V	CERAMIC
C 106	ECV1ZW20X53D	20PF	TRIMMER	CERAMIC
C 107	ECCW2H100F	10PF	500V	CERAMIC
C 109	ECV1ZW04X53D	4PF	TRIMMER	CERAMIC
C 110	ECCD1H221KC	220PF	50V	CERAMIC
C 111	ECV1ZW04X53D	4PF	TRIMMER	CERAMIC
C 112	ECKW1H103PF	0.01UF	50V	CERAMIC
C 113	ECKW1H331KB2	330PF	50V	CERAMIC
C 113	ECKW2H102PE	1000PF	500V	CERAMIC
C 114	ECEA1CS100	10UF	16V	ELECT.
C 115	ECEA1CS100	10UF	16V	ELECT.
C 116	ECEA1AS101	100UF	10V	ELECT.
C 117	ECEA1CS100	10UF	16V	ELECT.
C 119	ECCW1H470K	47PF	50V	CERAMIC
C 120	ECV1ZW70P32	70PF	VARIABLE CAP	CERAMIC
C 121	EC@M05102KZ	1000PF	50V	PLASTIC
C 122	ECCW1H220KC	22PF	50V	CERAMIC
C 123	ECKW1H103PF	0.01UF	50V	CERAMIC
C 124	ECKW1H103PF	0.01UF	50V	CERAMIC
C 130	ECKW1H103PF	0.01UF	50V	CERAMIC
C 131	ECKW1H103PF	0.01UF	50V	CERAMIC
C 132	ECKW1H103PF	0.01UF	50V	CERAMIC
C 134	ECKW1H331KB2	330PF	50V	CERAMIC
C 138	ECKW1H102KB2	1000PF	50V	CERAMIC
C 140	ECEA1CS100	10UF	16V	ELECT.
C 201	YC@MD12J473M	0.047UF	630V	PLASTIC
C 202	ECV1ZW20X53D	20PF	TRIMMER	CERAMIC
C 203	ECV1ZW04X53D	4PF	TRIMMER	CERAMIC
C 205	ECCW2H150F	15PF	500V	CERAMIC
C 206	ECV1ZW20X53D	20PF	TRIMMER	CERAMIC
C 207	ECCW2H100F	10PF	500V	CERAMIC
C 209	ECV1ZW04X53D	4PF	TRIMMER	CERAMIC
C 210	ECCD1H221KC	220PF	50V	CERAMIC
C 211	ECV1ZW04X53D	4PF	TRIMMER	CERAMIC
C 212	ECKW1H103PF	0.01UF	50V	CERAMIC
C 213	ECKW2H102PE	1000PF	500V	CERAMIC
C 214	ECEA1CS100	10UF	16V	ELECT.

P A R T S L I S T

CRT NO.	MFR. PART NO.	DISCRIPTION		
		CAPACITOR	(CONT)	
C 215	ECEA1CS100	10UF	16V	ELECT.
C 219	ECCw1H470K	47PF	50V	CERAMIC
C 220	ECV1ZW70P32	70PF	VARIABLE CAP	CERAMIC
C 221	ECQM05102KZ	1000PF	50V	PLASTIC
C 222	ECCw1H220KC	22PF	50V	CERAMIC
C 224	ECKw1H103PF	0.01UF	50V	CERAMIC
C 225	ECEB1VS100	10UF	35V	ELECT.
C 226	ECKw1H221KB2	220PF	50V	CERAMIC
C 227	ECKW1H221KB2	220PF	50V	CERAMIC
C 229	ECCW1H470K	47PF	50V	CERAMIC
C 230	ECCW1H470K	47PF	50V	CERAMIC
C 231	ECQM05152KZ	1500PF	50V	PLASTIC
C 232	ECCw1H101K	100PF	50V	CERAMIC
C 233	ECCw1H101K	100PF	50V	CERAMIC
C 235	ECKW1H102KB2	1000PF	50V	CERAMIC
C 236	ECKw1H102KB2	1000PF	50V	CERAMIC
C 237	ECKw1H103PF	0.01UF	50V	CERAMIC
C 242	ECCW1H220KC	22PF	50V	CERAMIC
C 243	ECCW1H220KC	22PF	50V	CERAMIC
C 301	ECCW1H101K	100PF	50V	CERAMIC
C 302	ECCW2H101K	100PF	500V	CERAMIC
C 303	ECKw2H103PE	0.01UF	500V	CERAMIC
C 305	ECKw2H102PE	1000PF	500V	CERAMIC
C 306	ECEA50N3R3U	3.3UF	50V	ELECT.
C 307	ECKW1H103PF	0.01UF	50V	CERAMIC
C 309	ECEA1CS100	10UF	16V	ELECT.
C 310	ECKW1H103PF	0.01UF	50V	CERAMIC
C 311	ECCw1H101K	100PF	50V	CERAMIC
C 312	ECKw1H102KB2	1000PF	50V	CERAMIC
C 313	ECCW1H150K	15PF	50V	CERAMIC
C 315	ECEA50ZR22	0.22UF	50V	ELECT.
C 316	ECEA50ZR22	0.22UF	50V	ELECT.
C 317	ECCW1H471K	470PF	50V	CERAMIC
C 319	ECCw1H330K	33PF	50V	CERAMIC
C 320	ECCw1H151KC2	150PF	50V	CERAMIC
C 321	ECCW1H101K	100PF	50V	CERAMIC
C 322	ECEA1CS100.	10UF	16V	ELECT.
C 325	ECCW1H560KC	56PF	50V	CERAMIC
C 326	ECQP1103FZ	0.01UF	DRAWING NO 77C10	
C 327	ECV1ZW20X53D	20PF	TRIMMER	CERAMIC

P A R T S L I S T

CRT NO.	MFR. PART NO.	DISCRIPTION			
		CAPACITOR (CONT)			
C 329	ECQK1105GG	1UF	2%	100V	PLASTIC
C 331	ECKW1H471KB	470PF		50V	CERAMIC
C 332	ECCW1H101K	100PF		50V	CERAMIC
C 335	ECEA1CS100	10UF		16V	ELECT.
C 336	ECEA1CS100	10UF		16V	ELECT.
C 338	ECKW1H103PF	0.01UF		50V	CERAMIC
C 339	ECKW1H103PF	0.01UF		50V	CERAMIC
C 342	ECEA1CS100	10UF		16V	ELECT.
C 345	ECCW1H470KC	47PF		50V	CERAMIC
C 346	ECKD1H222MD	2200PF		50V	CERAMIC
C 501	ECET35R222SW	2200UF		35V	ELECT.
C 502	ECEA1VS102	1000UF		35V	ELECT.
C 503	ECEA1CS221	220UF		16V	ELECT.
C 504	ECEA1CS221	220UF		16V	ELECT.
C 506	ECEA350V22L	22UF		350V	ELECT.
C 507	ECEA350V22L	22UF		350V	ELECT.
C 508	ECEA1H010	1UF		50V	ELECT.
C 509	ECEA350V22L	22UF		350V	ELECT.
C 510	ECEA350V22L	22UF		350V	ELECT.
C 511	YCKDCYZ472P2	4700PF		2KV	CERAMIC
C 512	YCKDCYZ472P2	4700PF		2KV	CERAMIC
C 513	YCKDCYZ472P2	4700PF		2KV	CERAMIC
C 514	YCKDCYZ472P2	4700PF		2KV	CERAMIC
C 515	ECEA1VS221	220UF		35V	ELECT.
C 522	ECKW1H223PF	0.022UF		50V	CERAMIC
C 523	ECQM05104KZ	0.1UF		50V	PLASTIC
C 524	ECKD3F102MB	1000PF		3KV	CERAMIC
C 526	ECQM05473KZ	0.047UF		50V	PLASTIC
C 530	ECKW2H472PE	4700PF		500V	CERAMIC
C 532	YCKDCYZ472P2	4700PF		2KV	CERAMIC
C 535	ECKW2H472PE	4700PF		500V	CERAMIC
C 536	ECKW2H472PE	4700PF		500V	CERAMIC
C 538	ECKW2H103PE	0.01UF		500V	CERAMIC
C 539	ECKW2H103PE	0.01UF		500V	CERAMIC
C 540	ECKW2H103PE	0.01UF		500V	CERAMIC
C 541	ECKW1H102PF	1000PF		50V	CERAMIC
		DIODE			
CR101	YUD1S1544A	DRAWING NO 77A23			SILICON
CR104	MA150-TAP	MA150			SILICON

P A R T S L I S T

CRT NO.	MFR. PART NO.	DISCRIPTION	
	DIODE	(CONT)	
CR105	MA150-TAP	MA150	SILICON
CR106	MA150-TAP	MA150	SILICON
CR107	MA150-TAP	MA150	SILICON
CR108	MA150-TAP	MA150	SILICON
CR110	MA150-TAP	MA150	SILICON
CR111	MA150-TAP	MA150	SILICON
CR115	MA150-TAP	MA150	SILICON
CR116	MA150-TAP	MA150	SILICON
CR201	YUD1S1544A	DRAWING NO 77A23	SILICON
CR207	MA150-TAP	MA150	SILICON
CR209	MA150-TAP	MA150	SILICON
CR210	MA150-TAP	MA150	SILICON
CR211	MA150-TAP	MA150	SILICON
CR212	MA150-TAP	MA150	SILICON
CR213	MA150-TAP	MA150	SILICON
CR215	MA150-TAP	MA150	SILICON
CR216	MA150-TAP	MA150	SILICON
CR217	MA150-TAP	MA150	SILICON
CR301	MA150-TAP	MA150	SILICON
CR302	MA150-TAP	MA150	SILICON
CR303	MA150-TAP	MA150	SILICON
CR304	MA150-TAP	MA150	SILICON
CR305	MA150-TAP	MA150	SILICON
CR306	MA150-TAP	MA150	SILICON
CR307	MA150-TAP	MA150	SILICON
CR309	MA150-TAP	MA150	SILICON
CR310	MA150-TAP	MA150	SILICON
CR312	MA150-TAP	MA150	SILICON
CR316	YUD1S1714-T	1S1714N-T	
CR317	YUD1S1714-T	1S1714N-T	
CR319	YUD1S1714-T	1S1714N-T	
CR320	YUD1S1714-T	1S1714N-T	
CR322	YUDSF1	SF-1	SILICON
CR323	YUDSF1	SF-1	SILICON
CR324	MA150-TAP	MA150	SILICON
CR326	MA150-TAP	MA150	SILICON
CR327	MA150-TAP	MA150	SILICON
CR501	YUDSIRB20	SIRB20	SILICON
CR502	YUDSIRB20	SIRB20	SILICON
CR503	MA150-TAP	MA150	SILICON

P A R T S L I S T

CRT NO.	MFR. PART NO.	DISCRIPTION		
		DIODE	(CONT)	
CR504	MA150-TAP	MA150		SILICON
CR505	MA150-TAP	MA150		SILICON
CR506	YUDV08J	V08J	RECTIFIER	SILICON
CR507	YUDV08J	V08J	RECTIFIER	SILICON
CR508	YUDV08J	V08J	RECTIFIER	SILICON
CR509	YUDV08J	V08J	RECTIFIER	SILICON
CR511	YUDED15TV1	ED15TV1		
CR516	YUDUF2	UF-2		SILICON
DS501	LN21	LN-21	RED	LED
		PC BOARD		
E 101	YXFP14000352	5102A V INITIAL BOARD		PCB ONLY
		HEAT SINK		
E 104	YXMG47012630	T34AL		
E 105	YXMG47012630	T34AL		
		PC BOARD		
E 301	YXFP14000341	5102A H INITIAL BOARD		PCB ONLY
E 302	YXFP44051710	5102B TIMING CKT		PCB ONLY
E 501	YXFP14000500	5102B POWER BOARD		PCB ONLY
		FUSE		
F 501	YXAFTSC1A	1A *(115V)	DRAWING NO. 77V05	
	YXAFTSC500MA	0.5A *(230V)	DRAWING NO. 77V05	
	*(SEE LINE VOLTAGE INDICATION ON REAR PANEL)			
F 502	YXAFTSC1A	1A		
		CONNECTOR		
J 101	YQBUG-625-U	UG-625/U	BNC CONTACT	
		BANANA JACK		
J 102	YQAXK1701-3	S-K 1701	BLACK	
		CONNECTOR		
J 103	YQA1163683-1	163683-1	SIDE ENTRY 3P	
J 105	YQA163683-3	163683-3	SIDE ENTRY 5P	
J 106	YQA163681-1	163681-1	BOTTOM ENTRY 3P	
J 107	YQA163681-3	BOTTOM ENTRY TYPE 5P		
J 109	YQA163681-3	BOTTOM ENTRY TYPE 5P		
J 110	YQA163681-8	163681-8	BOTTOM ENTRY 10P	

P A R T S L I S T

CRT NO.	MFR. PART NO.	DISCRIPTION
	CONNECTOR (CONT)	
J 202	YQBUG-625-U	UG-625/U BNC CONTACT
J 203	YQA1163683-1	163683-1 SIDE ENTRY 3P
J 206	YQA163681-1	163681-1 BOTTOM ENTRY 3P
J 207	YQA163681-3	BOTTOM ENTRY TYPE 5P
J 209	YQA163681-3	BOTTOM ENTRY TYPE 5P
J 301	YXFC77J09	BANANA JACK DRAWING NO 77J09
J 303	YQA1-1636814	1-163681-4 BOTTOM ENTRY 15P
J 310	YQA163680-3	163680-3 TOP ENTRY 5P
J 311	YQA163680-1	163680-1 TOP ENTRY 3P
J 312	YQA163680-1	163680-1 TOP ENTRY 3P
J 313	YQA1-1636814	1-163681-4 BOTTOM ENTRY 15P
J 502	YXFC73J021-P	8P PLUG
J 506	YQA163680-8	163680-8 10PIN
J 507	YQA163680-3	163680-3 TOP ENTRY 5P
J 509	YQA163680-3	163680-3 TOP ENTRY 5P
	COIL	
L 501	YXDL44311581	5100A ROTATION COIL
	CONNECTOR	
P 103	YQA163740-1	163740-1 CONNECTOR PIN 3P
P 105	YQA163740-3	163740-3 PIN 5P
P 106	YQA163740-1	163740-1 CONNECTOR PIN 3P
P 107	YQA163740-3	163740-3 PIN 5P
P 109	YQA163740-3	163740-3 PIN 5P
P 110	YQA163740-8	163740-8 10PIN
P 203	YQA163740-1	163740-1 CONNECTOR PIN 3P
P 206	YQA163740-1	163740-1 CONNECTOR PIN 3P
P 207	YQA163740-3	163740-3 PIN 5P
P 209	YQA163740-3	163740-3 PIN 5P
P 303	YQA1-1637404	1-163740-4 PIN 15P
P 310	YQA163740-3	163740-3 PIN 5P
P 311	YQA163740-1	163740-1 CONNECTOR PIN 3P
P 312	YQA163740-1	163740-1 CONNECTOR PIN 3P
P 313	YQA1-1637404	1-163740-4 PIN 15P
	POWER CORD	
P 501	YXFW74W015	2M (A2 TYPE) 125V 6A
	YXFW77W02	2M (A3 TYPE) 125V 10A
	YXFC1W008	2M (SHUKO TYPE) 250V 6A

(FOR LINE VOLTAGE FACTORY SELECTED)

P A R T S L I S T

CRT NO.	MFR. PART NO.	DISCRIPTION		
		CONNECTOR		
P 502	YXFC73J021-S	8P SOCKET		
P 506	YQA163740-8	163740-8	10PIN	
P 507	YQA163740-3	163740-3	PIN 5P	
P 509	YQA163740-3	163740-3	PIN 5P	
		TRANSISTOR		
Q 101	YUT2SK30AY	2SK30AY	FET	
Q 102	2SC828	2SC828		SILICON
Q 103	2SC828	2SC828		SILICON
Q 105	2SC1359-C	2SC1359-C		SILICON
Q 106	2SC1359-C	2SC1359-C		SILICON
Q 107	2SC1359-C	2SC1359-C		SILICON
Q 109	2SC1359-C	2SC1359-C		SILICON
Q 110	2SC828	2SC828		SILICON
Q 111	2SC828	2SC828		SILICON
Q 112	2SC1359-C	2SC1359-C		SILICON
Q 113	2SC1359-C	2SC1359-C		SILICON
Q 115	2SA564-RS	2SA564-RS		SILICON
Q 116	2SA564-RS	2SA564-RS		SILICON
Q 117	YUT2SC1834	2SC1834		SILICON
Q 119	YUT2SC1834	2SC1834		SILICON
Q 120	2SC1566	2SC1566		SILICON
Q 121	2SC1566	2SC1566		SILICON
Q 122	2SC1566	2SC1566		SILICON
Q 123	2SC1566	2SC1566		SILICON
Q 201	YUT2SK30AY	2SK30AY	FET	
Q 202	2SC828	2SC828		SILICON
Q 203	2SC828	2SC828		SILICON
Q 205	2SC1359-C	2SC1359-C		SILICON
Q 206	2SC1359-C	2SC1359-C		SILICON
Q 207	2SC1359-C	2SC1359-C		SILICON
Q 209	2SC1359-C	2SC1359-C		SILICON
Q 210	2SC828	2SC828		SILICON
Q 211	2SC828	2SC828		SILICON
Q 212	2SC1359-C	2SC1359-C		SILICON
Q 213	2SC1359-C	2SC1359-C		SILICON
Q 215	2SC1359-C	2SC1359-C		SILICON
Q 216	2SC828	2SC828		SILICON
Q 217	2SC828	2SC828		SILICON
Q 301	YUT2SK30A-GR	2SK30A-GR	FET	SILICON
Q 302	2SC1359-C	2SC1359-C		SILICON

P A R T S L I S T

CRT NO.	MFR. PART NO.	DISCRIPTION			
		TRANSISTOR (CONT)			
Q 303	2SC1359-C	2SC1359-C			SILICON
Q 305	2SC828	2SC828			SILICON
Q 306	2SC828	2SC828			SILICON
Q 307	2SC828-RS	2SC828-RS			SILICON
Q 309	2SC828	2SC828			SILICON
Q 310	2SC828	2SC828			SILICON
Q 311	2SC828-RS	2SC828-RS			SILICON
Q 312	2SC828-RS	2SC828-RS			SILICON
Q 314	YUT2SC1834	2SC1834			SILICON
Q 315	2SA564-RS	2SA564-RS			SILICON
Q 316	YUT2SK30A-GR	2SK30A-GR		FET	SILICON
Q 317	2SC1359-C	2SC1359-C			SILICON
Q 319	YUT2SC1834	2SC1834			SILICON
Q 320	2SA564-RS	2SA564-RS			SILICON
Q 321	2SA564-RS	2SA564-RS			SILICON
Q 322	2SC1566	2SC1566			SILICON
Q 323	2SC1566	2SC1566			SILICON
Q 505	2SD389-PQ	2SD389-PQ			SILICON
Q 506	2SC1509-RS	2SC1509-RS			SILICON
Q 507	2SA777-RS	2SA777-RS			SILICON
Q 509	2SA564-RS	2SA564-RS			SILICON
Q 510	2SC1953	2SC1953			SILICON
Q 511	2SC1566	2SC1566			SILICON
Q 512	2SC828-RS	2SC828-RS			SILICON
Q 513	2SA777-RS	2SA777-RS			SILICON
		RESISTOR			
R 101	ERD18TJ220V	22 OHM	5%	1/8W	CARBON
R 102	ERD18TJ331V	330 OHM	5%	1/8W	CARBON
R 103	ERO12CKF9003	900KOHM	1%	1/2W	METAL
R 105	ERO25CKF1103	110KOHM	1%	1/4W	METAL
R 106	ERO50CKF9903	990KOHM	1%	1/2W	METAL
R 107	ERO25CKF1012	10.1KOHM	1%	1/4W	METAL
R 109	ERO50CKF1004	1MOHM	1%	1/2W	METAL
R 110	ERD12TJ104	100KOHM	5%	1/2W	CARBON
R 111	ERD18TJ470V	47 OHM	5%	1/8W	CARBON
R 112	ERD18TJ473V	47KOHM	5%	1/8W	CARBON
R 115	ERD18TJ331V	330 OHM	5%	1/8W	CARBON
R 116	ERD18TJ682V	6.8KOHM	5%	1/8W	CARBON
R 117	YRVSR19R103B	10KOHM	VARIABLE		COMP.
R 119	ERD18TJ272V	2.7KOHM	5%	1/8W	CARBON

P A R T S L I S T

CRT NO.	MFR. PART NO.	DISCRIPTION			
		RESISTOR	(CONT)		
R 120	ERD18TJ822V	8.2KOHM	5%	1/8w	CARBON
R 121	ERD18TJ154V	150KOHM	5%	1/8w	CARBON
R 122	ERD18TJ470V	47 OHM	5%	1/8w	CARBON
R 123	ERD18TJ302	3KOHM	5%	1/8w	CARBON
R 124	ERD18TJ101V	100 OHM	5%	1/8w	CARBON
R 125	ERD ;TJ331V	330 OHM	5%	1/8w	CARBON
R 126	ERD18TJ152V	1.5KOHM	5%	1/8w	CARBON
R 127	E D18TJ682V	6.8KOHM	5%	1/8w	CARBON
R 128	ERD18TJ101V	100 OHM	5%	1/8w	CARBON
R 129	ERD18TJ101V	100 OHM	5%	1/8w	CARBON
R 130	ERD18TJ101V	100 OHM	5%	1/8w	CARBON
R 131	ERD18TJ272V	2.7KOHM	5%	1/8w	CARBON
R 132	ERD18TJ272V	2.7KOHM	5%	1/8w	CARBON
R 133	ERD18TJ151V	150 OHM	5%	1/8w	CARBON
R 134	ERD18TJ151V	150 OHM	5%	1/8w	CARBON
R 135	ERO25CKF82R5	82.5 OHM	1%	1/4w	METAL
R 136	ERO25CKF1000	100 OHM	1%	1/4w	METAL
R 137	ERO25CKF3240	324 OHM	1%	1/4w	METAL
R 138	ERD18TJ470V	47 OHM	5%	1/8w	CARBON
R 139	ERD18TJ123V	12KOHM	5%	1/8w	CARBON
R 140	ERD18TJ303V	30KOHM	5%	1/8w	CARBON
R 141	ERD18TJ223V	22KOHM	5%	1/8w	CARBON
R 142	ERD18TJ222V	2.2KOHM	5%	1/8w	CARBON
R 143	ERD18TJ222V	2.2KOHM	5%	1/8w	CARBON
R 145	ERD18TJ241V	240 OHM	5%	1/8w	CARBON
R 146	ERD18TJ241V	240 OHM	5%	1/8w	CARBON
R 147	ERD18TJ911V	910 OHM	5%	1/8w	CARBON
R 148	ERD18TJ152V	1.5KOHM	5%	1/8w	CARBON
R 149	YRVSR19R101B	100 OHM	VARIABLE		COMP.
R 150	ERD18TJ101V	100 OHM	5%	1/8w	CARBON
R 151	ERD18TJ471V	470 OHM	5%	1/8w	CARBON
R 152	ERD18TJ272V	2.7KOHM	5%	1/8w	CARBON
R 153	ERD18TJ393V	39KOHM	5%	1/8w	CARBON
R 154	ERD18TJ751	750 OHM	5%	1/8w	CARBON
R 155	EVTR3AA00B52	500 OHM	VARIABLE		CARBON
R 156	EVH79AK20B52	500 OHM	VARIABLE		CARBON
R 157	ERD18TJ470V	47 OHM	5%	1/8w	CARBON
R 158	ERD18TJ220V	22 OHM	5%	1/8w	CARBON
R 159	ERD18TJ332V	3.3KOHM	5%	1/8w	CARBON
R 160	ERD18TJ332V	3.3KOHM	5%	1/8w	CARBON

P A R T S L I S T

CRT NO.	MFR. PART NO.	DISCRIPTION		
	RESISTOR	(CONT)		
R 161	ERD18TJ153V	15KOHM	5% 1/8W	CARBON
R 162	ERD18TJ153V	15KOHM	5% 1/8W	CARBON
R 163	ERD18TJ471V	470 OHM	5% 1/8W	CARBON
R 165	ERD18TJ471V	470 OHM	5% 1/8W	CARBON
R 166	EVH79AK20B23	2KOHM	VARIABLE	CARBON
R 167	ERD18TJ220V	22 OHM	5% 1/8W	CARBON
R 168	ERD18TJ220V	22 OHM	5% 1/8W	CARBON
R 169	ERD18TJ122V	1.2KOHM	5% 1/8W	CARBON
R 170	ERD18TJ153V	15KOHM	5% 1/8W	CARBON
R 171	EVTR3AA00B52	500 OHM	VARIABLE	CARBON
R 172	ERD18TJ153V	15KOHM	5% 1/8W	CARBON
R 173	ERD18TJ242V	2.4KOHM	5% 1/8W	CARBON
R 174	ERD18TJ242V	2.4KOHM	5% 1/8W	CARBON
R 175	ERD18TJ153V	15KOHM	5% 1/8W	CARBON
R 176	ERD18TJ153V	15KOHM	5% 1/8W	CARBON
R 177	ERD18TJ331V	330 OHM	5% 1/8W	CARBON
R 178	ERD14TJ392	3.9KOHM	5% 1/4W	CARBON
R 179	ERD14TJ392	3.9KOHM	5% 1/4W	CARBON
R 182	ERD18TJ4R7	4.7 OHM	5% 1/8W	CARBON
R 183	ERD18TJ4R7	4.7 OHM	5% 1/8W	CARBON
R 184	ERD14TJ511	510 OHM	5% 1/4W	CARBON
R 185	ERD14TJ511	510 OHM	5% 1/4W	CARBON
R 186	ERG1ANJ433	43KOHM	5% 1W	METAL
R 187	ERG1ANJ433	43KOHM	5% 1W	METAL
R 188	ERD18TJ470V	47 OHM	5% 1/8W	CARBON
R 189	ERD18TJ470V	47 OHM	5% 1/8W	CARBON
R 190	ERD18TJ221V	220 OHM	5% 1/8W	CARBON
R 191	ERD14TJ331	330 OHM	5% 1/4W	CARBON
R 192	ERD14TJ331	330 OHM	5% 1/4W	CARBON
R 193	ERG2ANJ333	33KOHM	5% 2W	METAL
R 194	ERG2ANJ333	33KOHM	5% 2W	METAL
R 195	ERD14TJ184	180KOHM	5% 1/4W	CARBON
R 196	ERD18TJ153V	15KOHM	5% 1/8W	CARBON
R 201	ERD18TJ220V	22 OHM	5% 1/8W	CARBON
R 202	ERD18TJ331V	330 OHM	5% 1/8W	CARBON
R 203	ERO12CKF9003	900KOHM	1% 1/2W	METAL
R 205	ERO25CKF1103	110KOHM	1% 1/4W	METAL
R 206	ERO50CKF9903	990KOHM	1% 1/2W	METAL
R 207	ERO25CKF1012	10.1KOHM	1% 1/4W	METAL
R 209	ERO50CKF1004	1MOHM	1% 1/2W	METAL

P A R T S L I S T

CRT NO.	MFR. PART NO.	DISCRIPTION		
	RESISTOR	(CONT)		
R 210	ERD12TJ104	100KOHM	5% 1/2w	CARBON
R 211	ERD18TJ470V	47 OHM	5% 1/8w	CARBON
R 212	ERD18TJ473V	47KOHM	5% 1/8w	CARBON
R 215	ERD18TJ331V	330 OHM	5% 1/8w	CARBON
R 216	ERD18TJ682V	6.8KOHM	5% 1/8w	CARBON
R 217	YRVSR19R103B	10KOHM	VARIABLE	COMP.
R 219	ERD18TJ272V	2.7KOHM	5% 1/8w	CARBON
R 220	ERD18TJ822V	8.2KOHM	5% 1/8w	CARBON
R 221	ERD18TJ154V	150KOHM	5% 1/8w	CARBON
R 222	ERD18TJ470V	47 OHM	5% 1/8w	CARBON
R 223	ERD18TJ302	3KOHM	5% 1/8w	CARBON
R 224	ERD18TJ101V	100 OHM	5% 1/8w	CARBON
R 225	ERD18TJ331V	330 OHM	5% 1/8w	CARBON
R 227	ERD18TJ682V	6.8KOHM	5% 1/8w	CARBON
R 228	ERD18TJ101V	100 OHM	5% 1/8W	CARBON
R 229	ERD18TJ101V	100 OHM	5% 1/8W	CARBON
R 230	ERD18TJ101V	100 OHM	5% 1/8w	CARBON
R 231	ERD18TJ272V	2.7KOHM	5% 1/8w	CARBON
R 232	ERD18TJ272V	2.7KOHM	5% 1/8w	CARBON
R 235	ERO25CKF82R5	82.5 OHM	1% 1/4w	METAL
R 236	ERO25CKF1000	100 OHM	1% 1/4w	METAL
R 237	ERO25CKF3240	324 OHM	1% 1/4w	METAL
R 245	ERD18TJ241V	240 OHM	5% 1/8W	CARBON
R 246	ERD18TJ241V	240 OHM	5% 1/8w	CARBON
R 247	ERD18TJ911V	910 OHM	5% 1/8w	CARBON
R 249	YRVSR19R101B	100 OHM	VARIABLE	COMP.
R 250	ERD18TJ101V	100 OHM	5% 1/8w	CARBON
R 251	ERD18TJ471V	470 OHM	5% 1/8w	CARBON
R 252	ERD18TJ272V	2.7KOHM	5% 1/8w	CARBON
R 253	ERD18TJ393V	39KOHM	5% 1/8w	CARBON
R 254	ERD18TJ751	750 OHM	5% 1/8w	CARBON
R 255	EVTR3AA00B52	500 OHM	VARIABLE	CARBON
R 256	EVH79AK20B52	500 OHM	VARIABLE	CARBON
R 257	ERD18TJ470V	47 OHM	5% 1/8W	CARBON
R 258	ERD18TJ220V	22 OHM	5% 1/8w	CARBON
R 259	ERD18TJ332V	3.3KOHM	5% 1/8w	CARBON
R 260	ERD18TJ332V	3.3KOHM	5% 1/8w	CARBON
R 261	ERD18TJ153V	15KOHM	5% 1/8w	CARBON
R 262	ERD18TJ153V	15KOHM	5% 1/8w	CARBON
R 263	ERD18TJ471V	470 OHM	5% 1/8w	CARBON

P A R T S L I S T

CRT NO.	MFR. PART NO.	DISCRIPTION		
	RESISTOR	(CONT)		
R 265	ERD18TJ471V	470 OHM	5% 1/8w	CARBON
R 266	EVH79AK20B23	2KOHM	VARIABLE	CARBON
R 269	ERD18TJ470V	47 OHM	5% 1/8w	CARBON
R 270	ERD18TJ122V	1.2KOHM	5% 1/8w	CARBON
R 271	ERD18TJ122V	1.2KOHM	5% 1/8w	CARBON
R 272	ERD18TJ682V	6.8KOHM	5% 1/8w	CARBON
R 273	ERD18TJ682V	6.8KOHM	5% 1/8w	CARBON
R 275	ERD18TJ562V	5.6KOHM	5% 1/8w	CARBON
R 276	ERD18TJ562V	5.6KOHM	5% 1/8w	CARBON
R 277	ERD14TJ511	510 OHM	5% 1/4w	CARBON
R 279	ERD14TJ511	510 OHM	5% 1/4w	CARBON
R 280	ERD18TJ471V	470 OHM	5% 1/8w	CARBON
R 281	ERD18TJ222V	2.2KOHM	5% 1/8w	CARBON
R 282	ERD18TJ222V	2.2KOHM	5% 1/8w	CARBON
R 283	ERD14TJ471	470 OHM	5% 1/4w	CARBON
R 285	ERD18TJ104V	100KOHM	5% 1/8w	CARBON
R 286	ERD18TJ104V	100KOHM	5% 1/8w	CARBON
R 287	ERD18TJ154V	150KOHM	5% 1/8w	CARBON
R 291	ERD18TJ823	82KOHM	5% 1/8w	CARBON
R 292	ERD18TJ103V	10KOHM	5% 1/8w	CARBON
R 295	ERD18TJ332V	3.3KOHM	5% 1/8w	CARBON
R 296	ERD18TJ332V	3.3KOHM	5% 1/8w	CARBON
R 297	ERD18TJ223V	22KOHM	5% 1/8w	CARBON
R 298	ERD18TJ223V	22KOHM	5% 1/8w	CARBON
R 301	ERD18TJ103V	10KOHM	5% 1/8w	CARBON
R 302	ERD18TJ103V	10KOHM	5% 1/8w	CARBON
R 303	ERD18TJ333V	33KOHM	5% 1/8w	CARBON
R 305	ERD18TJ104V	100KOHM	5% 1/8w	CARBON
R 306	ERD12TJ105	1MOHM	5% 1/2w	CARBON
R 307	ERD12TJ225	2.2MOHM	5% 1/2w	CARBON
R 308	ERD18TJ331V	330 OHM	5% 1/8w	CARBON
R 309	ERD12TJ104	100KOHM	5% 1/2w	CARBON
R 310	ERD18TJ470V	47 OHM	5% 1/8w	CARBON
R 311	ERD18TJ101V	100 OHM	5% 1/8w	CARBON
R 312	ERD18TJ153V	15KOHM	5% 1/8w	CARBON
R 313	ERD18TJ103V	10KOHM	5% 1/8w	CARBON
R 315	EVH79AK20B14	10KOHM	VARIABLE	CARBON
R 316	ERD18TJ273V	27KOHM	5% 1/8w	CARBON
R 317	ERD18TJ472V	4.7KOHM	5% 1/8w	CARBON
R 319	ERD18TJ470V	47 OHM	5% 1/8w	CARBON

P A R T S L I S T

CRT NO.	MFR. PART NO.	DISCRIPTION			
		RESISTOR	(CONT)		
R 320	ERD18TJ470V	47 OHM	5%	1/8w	CARBON
R 321	ERD18TJ392V	3.9KOHM	5%	1/8w	CARBON
R 322	ERD18TJ392V	3.9KOHM	5%	1/8w	CARBON
R 323	ERD18TJ470V	47 OHM	5%	1/8w	CARBON
R 325	ERD18TJ391V	390 OHM	5%	1/8w	CARBON
R 326	ERD18TJ391V	390 OHM	5%	1/8w	CARBON
R 327	ERD18TJ271V	270 OHM	5%	1/8w	CARBON
R 328	ERD18TJ331V	330 OHM	5%	1/8w	CARBON
R 329	ERD18TJ332V	3.3KOHM	5%	1/8w	CARBON
R 330	ERD18TJ123V	12KOHM	5%	1/8w	CARBON
R 331	ERD18TJ680V	68 OHM	5%	1/8w	CARBON
R 332	ERD18TJ272V	2.7KOHM	5%	1/8w	CARBON
R 333	ERD18TJ271V	270 OHM	5%	1/8w	CARBON
R 334	ERD18TJ223V	22KOHM	5%	1/8w	CARBON
R 335	ERC14GK475	4.7MOHM	10%	1/4w	COMP.
R 336	ERD18TJ103V	10KOHM	5%	1/8w	CARBON
R 337	ERD18TJ222V	2.2KOHM	5%	1/8w	CARBON
R 339	ERD18TJ222V	2.2KOHM	5%	1/8w	CARBON
R 340	ERD18TJ223V	22KOHM	5%	1/8w	CARBON
R 341	ERD18TJ223V	22KOHM	5%	1/8w	CARBON
R 342	ERD18TJ104V	100KOHM	5%	1/8w	CARBON
R 343	ERD18TJ333V	33KOHM	5%	1/8w	CARBON
R 345	ERD18TJ153V	15KOHM	5%	1/8w	CARBON
R 346	ERD18TJ153V	15KOHM	5%	1/8w	CARBON
R 347	ERD18TJ102V	1KOHM	5%	1/8w	CARBON
R 348	ERD18TJ102V	1KOHM	5%	1/8w	CARBON
R 349	ERD18TJ511	510 OHM	5%	1/8w	CARBON
R 350	ERD18TJ103V	10KOHM	5%	1/8w	CARBON
R 351	ERD18TJ332V	3.3KOHM	5%	1/8w	CARBON
R 352	ERD18TJ123V	12KOHM	5%	1/8w	CARBON
R 353	ERD18TJ272V	2.7KOHM	5%	1/8w	CARBON
R 354	ERD18TJ152V	1.5KOHM	5%	1/8w	CARBON
R 355	ERD18TJ102V	1KOHM	5%	1/8w	CARBON
R 356	ERD18TJ471V	470 OHM	5%	1/8w	CARBON
R 357	ERD18TJ303V	30KOHM	5%	1/8w	CARBON
R 358	ERD18TJ334V	330KOHM	5%	1/8w	CARBON
R 359	ERD18TJ102V	1KOHM	5%	1/8w	CARBON
R 360	EVHZ71Z03B23	2KOHM	VARIABLE & SWITCH		
R 361	ERD18TJ222V	2.2KOHM	5%	1/8W	CARBON
R 363	ERO25CKF2212	22.1KOHM	1%	1/4w	METAL

P A R T S L I S T

CRT NO.	MFR. PART NO.	DISCRIPTION			
		RESISTOR	(CONT)		
R 364	ERO50CKF4423	442KOHM	1%	1/2w	METAL
R 365	ERO25CKF1103	110KOHM	1%	1/4w	METAL
R 366	ERO25CKF2213	221KOHM	1%	1/4w	METAL
R 367	ERL12CKF2204	2.2MOHM	1%	1/2w	METAL
R 368	ERL12CKF1104	1.1MOHM	1%	1/2w	METAL
R 369	ERO25CKF4422	44.2KOHM	1%	1/4w	METAL
R 370	ERD18TJ183V	18KOHM	5%	1/8w	CARBON
R 371	ERD18TJ822V	8.2KOHM	5%	1/8w	CARBON
R 372	ERD18TJ123V	12KOHM	5%	1/8w	CARBON
R 373	ERD18TJ222V	2.2KOHM	5%	1/8w	CARBON
R 374	ERD18TJ102V	1KOHM	5%	1/8w	CARBON
R 375	ERD18TJ332V	3.3KOHM	5%	1/8w	CARBON
R 376	EVTR3AA00B13	1KOHM	VARIABLE		CARBON
R 377	ERD18TJ103V	10KOHM	5%	1/8w	CARBON
R 379	ERD18TJ512V	5.1KOHM	5%	1/8w	CARBON
R 381	ERD18TJ133	13KOHM	5%	1/8w	CARBON
R 382	EVH79AK20B14	10KOHM	VARIABLE		CARBON
R 383	ERD18TJ103V	10KOHM	5%	1/8w	CARBON
R 384	ERD18TJ823	82KOHM	5%	1/8w	CARBON
R 385	ERD18TJ222V	2.2KOHM	5%	1/8w	CARBON
R 385	ERD18TJ182V	1.8KOHM	5%	1/8w	CARBON
R 386	ERD18TJ752	7.5KOHM	5%	1/8w	CARBON
R 387	ERD18TJ752	7.5KOHM	5%	1/8w	CARBON
R 388	ERD18TJ103V	10KOHM	5%	1/8w	CARBON
R 391	ERD18TJ331V	330 OHM	5%	1/8w	CARBON
R 392	EVTR3AA00B52	500 OHM	VARIABLE		CARBON
R 393	ERD18TJ332V	3.3KOHM	5%	1/8w	CARBON
R 395	EVTR3AA00B23	2KOHM	VARIABLE		CARBON
R 396	ERD18TJ100V	10 OHM	5%	1/8w	CARBON
R 397	ERD18TJ100V	10 OHM	5%	1/8w	CARBON
R 401	ERD18TJ362	3.6KOHM	5%	1/8w	CARBON
R 402	ERD18TJ362	3.6KOHM	5%	1/8w	CARBON
R 403	ERD12TJ431	430 OHM	5%	1/2w	CARBON
R 405	ERD12TJ124	120KOHM	5%	1/2w	CARBON
R 406	ERD12TJ124	120KOHM	5%	1/2w	CARBON
R 407	ERG3ANJ153	15KOHM	5%	3W	METAL
R 409	ERG3ANJ153	15KOHM	5%	3W	METAL
R 410	ERD18TJ154V	150KOHM	5%	1/8w	CARBON
R 411	ERD18TJ154V	150KOHM	5%	1/8w	CARBON
R 412	ERD18TJ334V	330KOHM	5%	1/8w	CARBON

P A R T S L I S T

CRT NO.	MFR. PART NO.	DISCRIPTION			
		RESISTOR	(CONT)		
R 413	ERD18TJ334V	330KOHM	5%	1/8W	CARBON
R 415	ERC14GJ155	1.5MOHM	5%	1/4W	COMP.
R 416	ERD14TJ105	1MOHM	5%	1/4W	CARBON
R 509	YXBV76R007	10KOHM	VARIABLE		
R 510	ERD18TJ102V	1KOHM	5%	1/8W	CARBON
R 511	ERD12TJ242	2.4KOHM	5%	1/2W	CARBON
R 513	ERD18TJ102V	1KOHM	5%	1/8W	CARBON
R 515	ERD14TJ105	1MOHM	5%	1/4W	CARBON
R 516	ERD18TJ104V	100KOHM	5%	1/8W	CARBON
R 517	EVTJOAS05B14	10KOHM	VARIABLE		
R 518	ERD18TJ103V	10KOHM	5%	1/8W	CARBON
R 519	ERD18TJ471V	470 OHM	5%	1/8W	CARBON
R 520	ERG3ANJ331	330 OHM	5%	3W	METAL
R 521	ERX2ANJ2R7	2.7 OHM	5%	2W	METAL
R 522	ERD18TJ103V	10KOHM	5%	1/8W	CARBON
R 523	YRHMG1G24M	24MOHM	2%	1W	METAL
R 525	ERD12TJ511	510 OHM	5%	1/2W	CARBON
R 526	ERD18TJ474V	470KOHM	5%	1/8W	CARBON
R 527	ERD18TJ103V	10KOHM	5%	1/8W	CARBON
R 529	ERD18TJ102V	1KOHM	5%	1/8W	CARBON
R 530	ERD18TJ101V	100 OHM	5%	1/8W	CARBON
R 537	ERD14TJ824	820KOHM	5%	1/4W	CARBON
R 539	ERD12TJ334	330KOHM	5%	1/2W	CARBON
R 540	ERD12TJ334	330KOHM	5%	1/2W	CARBON
R 545	ERD18TJ103V	10KOHM	5%	1/8W	CARBON
R 546	EVHOXAS20B55	500KOHM	VARIABLE		
R 547	ERD18TJ334V	330KOHM	5%	1/8W	CARBON
R 548	ERD18TJ474V	470KOHM	5%	1/8W	CARBON
R 549	EVHOXAS20B16	1MOHM	VARIABLE		
R 550	ERD14TJ105	1MOHM	5%	1/4W	CARBON
R 551	ERD14TJ105	1MOHM	5%	1/4W	CARBON
R 552	ERD14TJ105	1MOHM	5%	1/4W	CARBON
R 553	ERD14TJ105	1MOHM	5%	1/4W	CARBON
R 554	ERD14TJ124	120KOHM	5%	1/4W	CARBON
R 555	ERD14TJ823	82KOHM	5%	1/4W	CARBON
R 556	EVTJOAS05B25	200KOHM	VARIABLE		
R 560	ERC14GK475	4.7MOHM	10%	1/4W	COMP.
R 561	ERC14GK475	4.7MOHM	10%	1/4W	COMP.
R 562	ERD14TJ473	47KOHM	5%	1/4W	CARBON
R 563	ERG2ANJ823	82KOHM	5%	2W	METAL

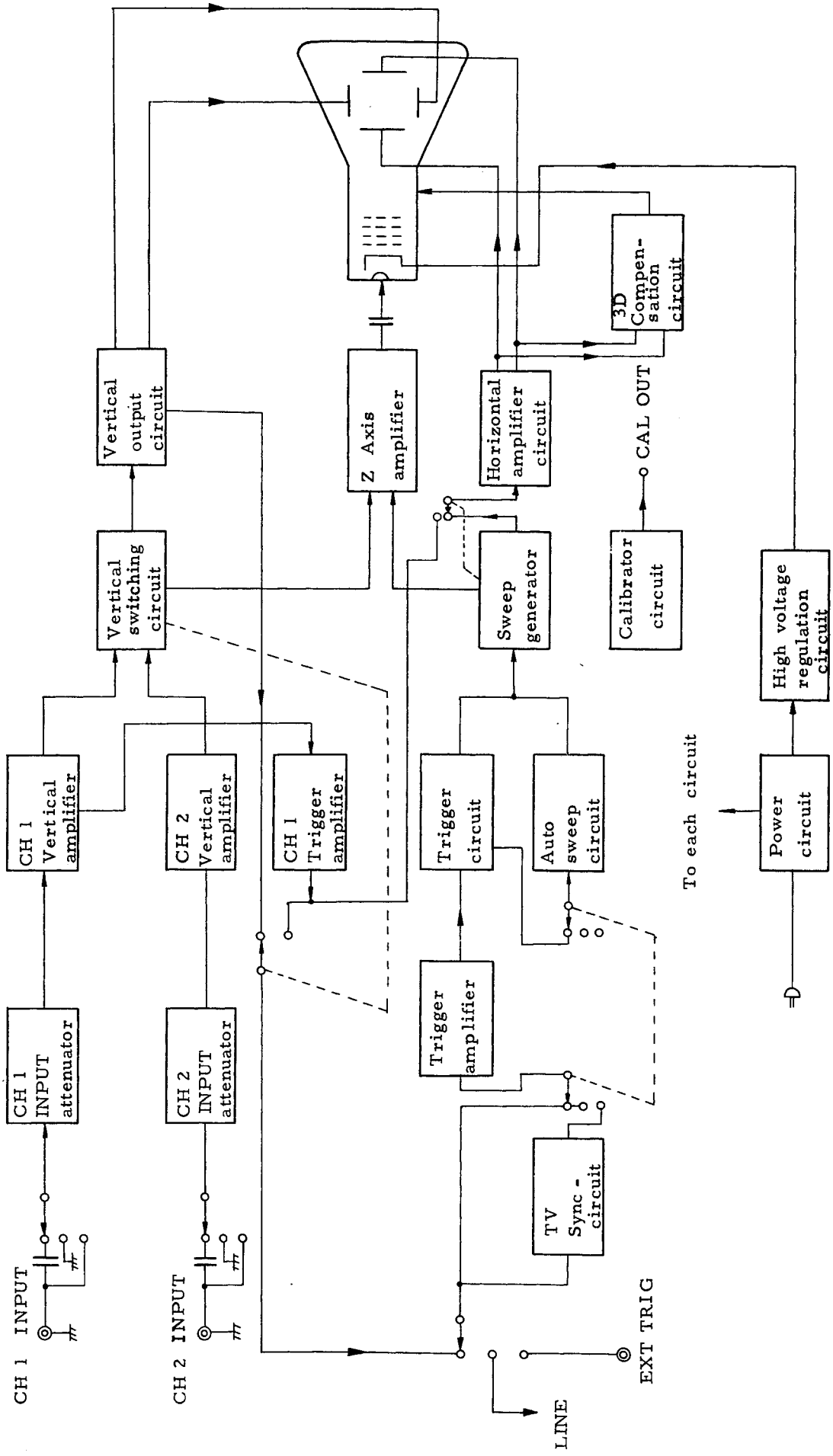
P A R T S L I S T

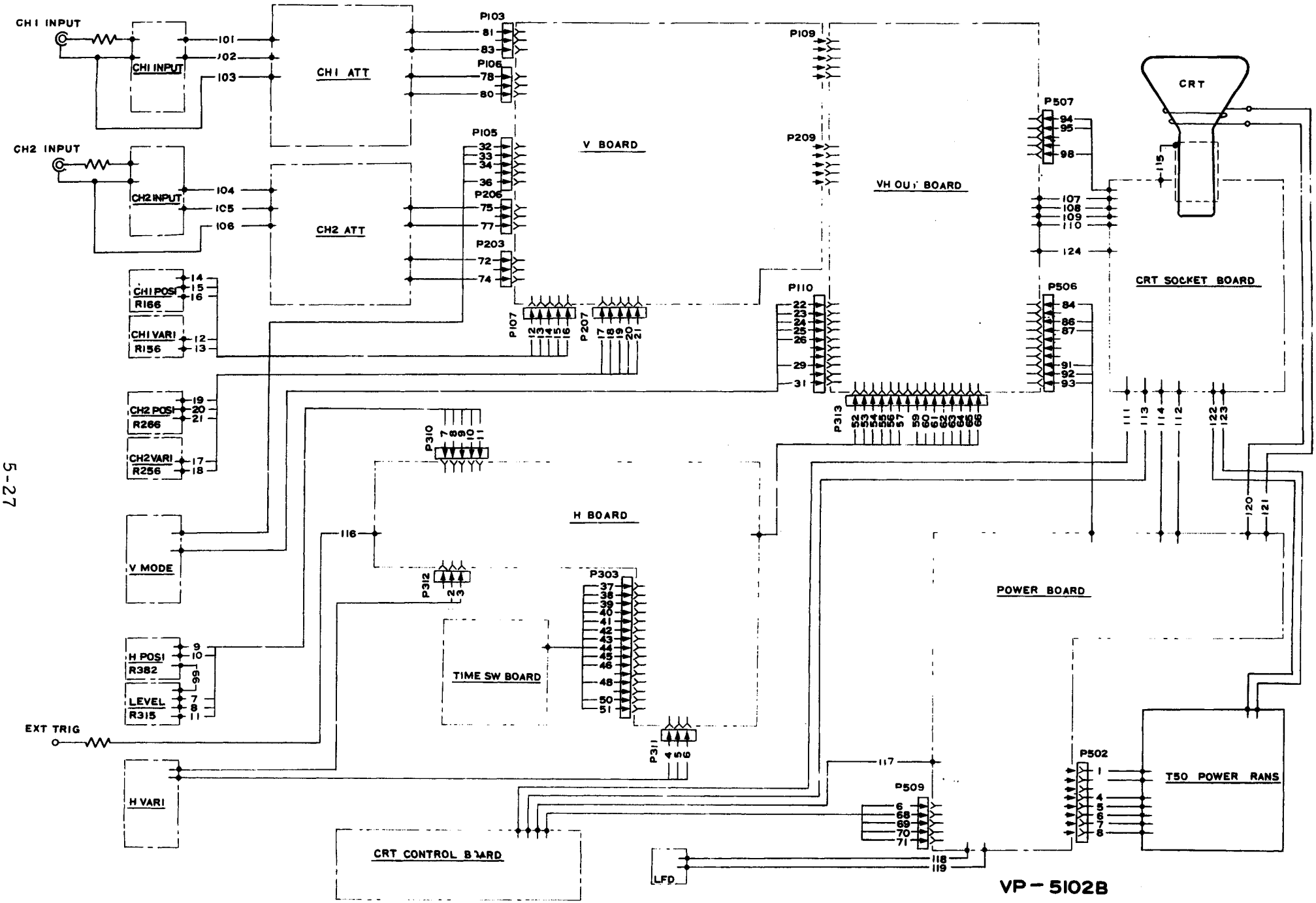
CRT NO.	MFR. PART NO.	DISCRIPTION			
		RESISTOR (CONT)			
R 566	ERD14TJ683	68KOHM	5%	1/4w	CARBON
R 567	ERD18TJ181V	180 OHM	5%	1/8w	CARBON
		SWITCH			
S 101	YXES76S026	SSB-2-3			SLIDE
S 102	YXER77S51	5102A ATT SWITCH			ROTARY
S 201	YXES76S026	SSB-2-3			SLIDE
S 202	YXER77S51	5102A ATT SWITCH			ROTARY
S 203	YSLSLE52301	SLE-52301			SLIDE
S 301	YXEL77S53	SLR-023			LEVER
S 302	YXEL77S53	SLR-023			LEVER
S 303	YXEL77S52	SLR-022			LEVER
S 305	YXER34102310	5102B TIMING SWITCH			ROTARY
S 501	ESB701T	MATSUSHITA DENKO			
		TRANSFORMER			
T 501	YXDP34304181	5100B POWER TRANSFORMER (5102B)			
T 502	YXDP34304190	5100B HIGH VOLTAGE TRANSFORMER			
		IC			
U 501	YHTUPC14315H	UPC14315H			
U 502	YHTUPC14315H	UPC14315H			
		CATHODE-RAY TUBE			
V 501	140AYB31	DRAWING NO 76V007			
		DIODE			
VR103	YUDXZ057	XZ-057			ZENER
VR112	YUDXZ057	XZ-057			ZENER
VR113	YUDXZ057	XZ-057			ZENER
VR321	YUDXZ265	XZ-265			
		FUSE HOLDER			
XF501	YXFS75A007	S-N5053 FUSE CLIP			
XF502	YXFS75A007	S-N5053 FUSE CLIP			
XF503	YXFSSN2250	SN-2250			
		SOCKET			
XV501	YXFS76J019	CRT SOCKET HPS069			

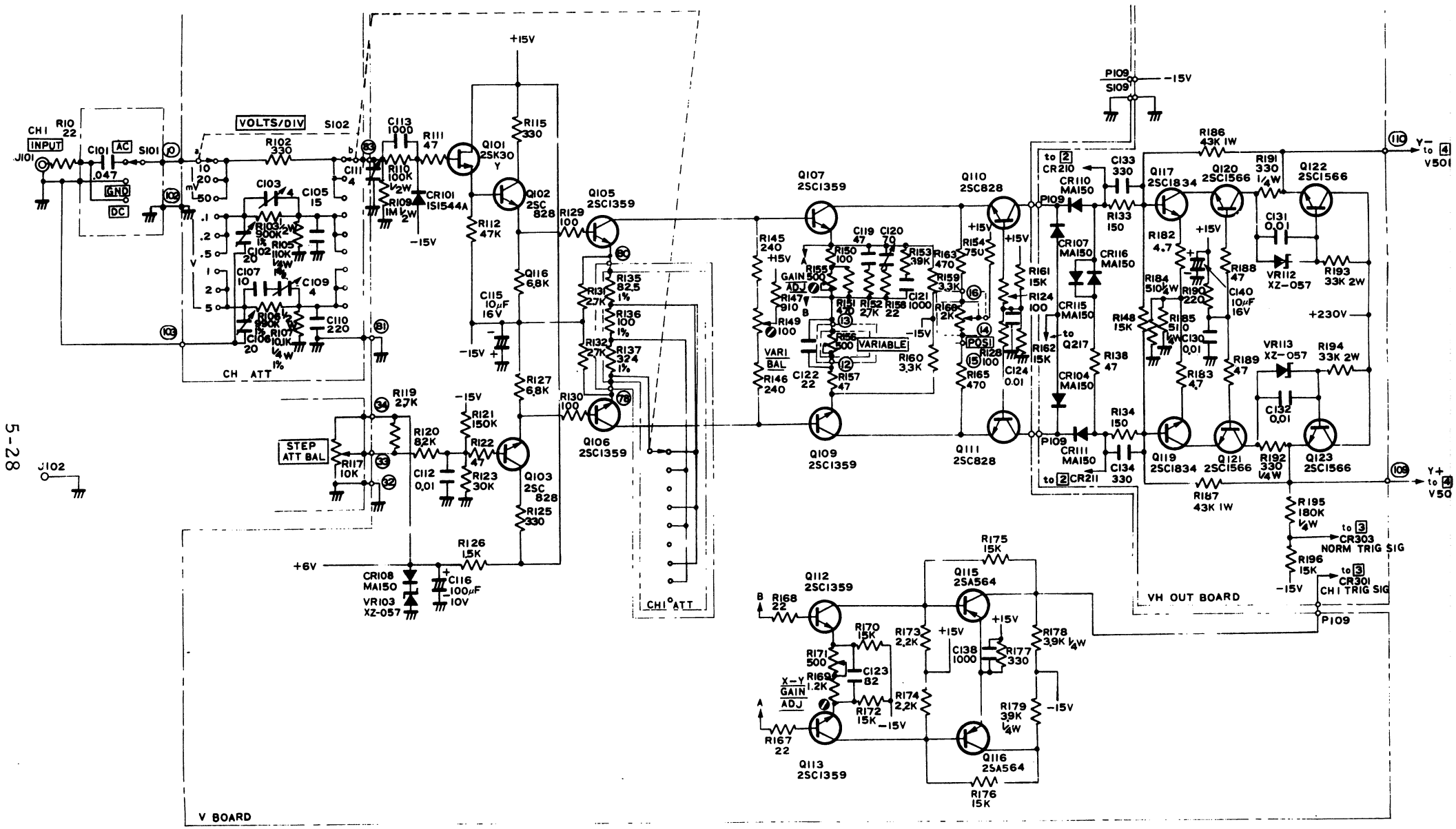
P A R T S L I S T

CRT NO.	MFR. PART NO.	DISCRIPTION
	BEZEL	
	YXMG37001530	5100A-BEZEL
	HANDLE	
	YXLSA164	A-164
	KNOB	
	YXMK10N6WS	DRAWING NO 3G-60-0315
	YXMK10N6KSR	DRAWING NO 3G-60-0321
	YXMK10N6KS	DRAWING NO 3G-60-0163
	YXMK23S6KS	DRAWING NO 3G-60-0303
	YXMK10N3W	DRAWING NO 3G-60-0316
	SOCKET	
	YXFC46004190	CRT SIDEPIN SOCKET

5.5 Block Diagram

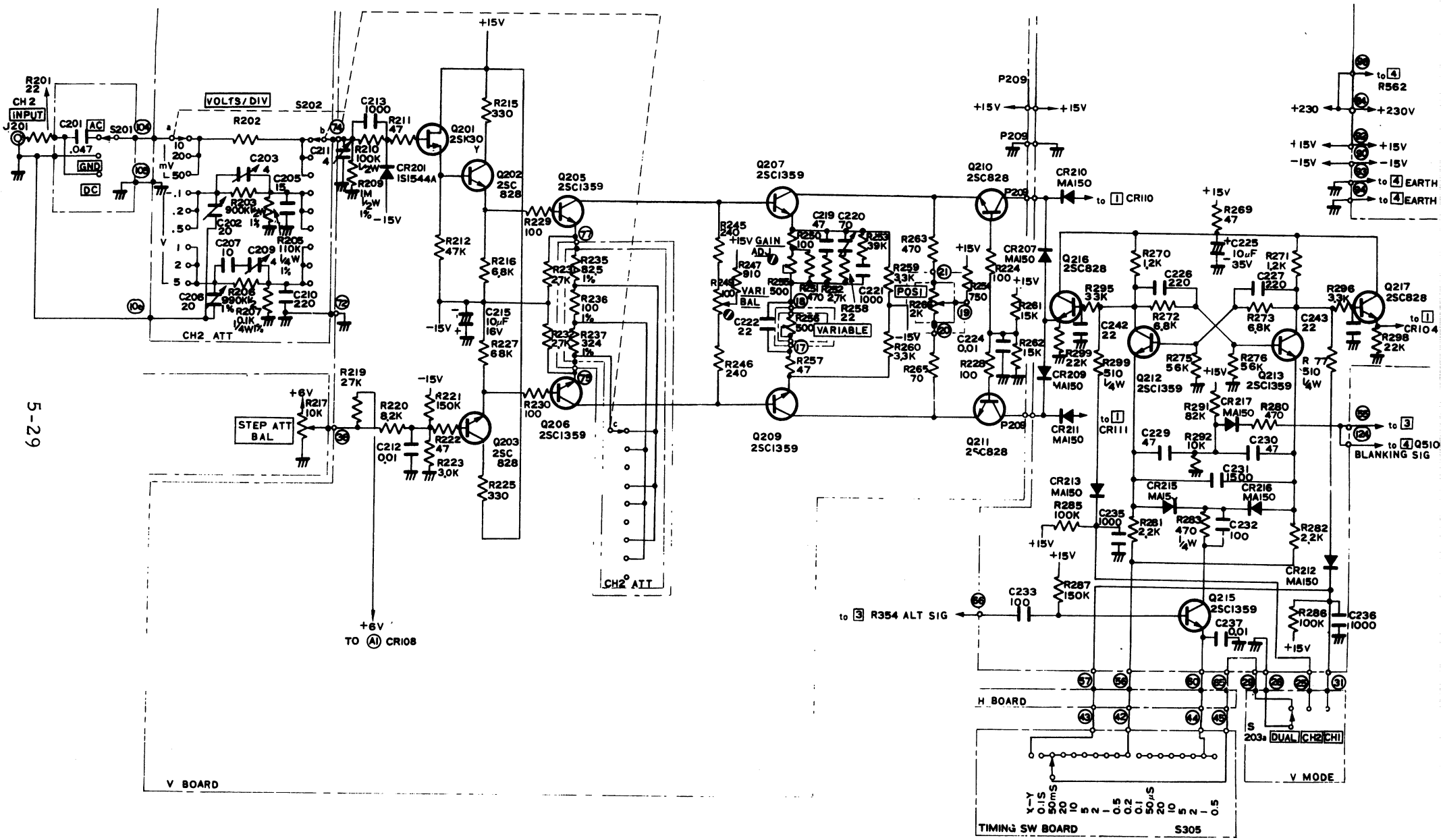



CH1 INPUT
CH1 INPUT
CH1 ATT
CH2 INPUT
CH2 INPUT
CH2 ATT
V BOARD
VH OUT BOARD
CRT
CRT SOCKET BOARD
CH1 POSI R166
CH1 VARI R156
CH2 POSI R266
CH2 VARI R256
V MODE
H BOARD
H POSI R382
LEVEL R315
H VARI
EXT TRIG
TIME SW BOARD
POWER BOARD
T50 POWER RANS
CRT CONTROL BOARD
LFD
P103
P105
P106
P206
P203
P107
P207
P109
P209
P110
P313
P507
P506
P310
P312
P303
P311
P509
P502
VP-5102B
OVERALL INTERCONNECTION AO



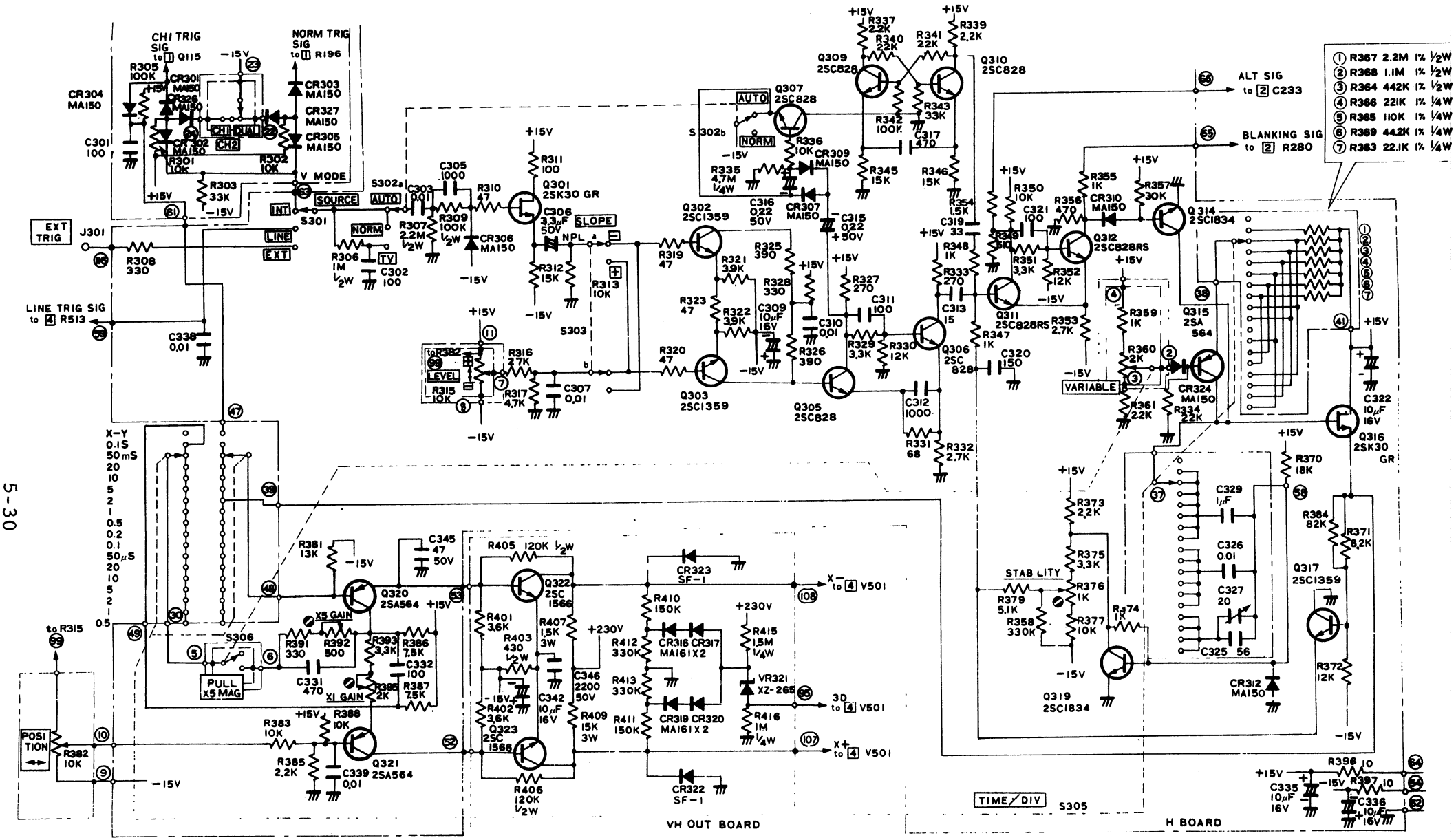
VP-5102B

CH1 PREAMP & V MAIN AMP (A1)



VP-5102B

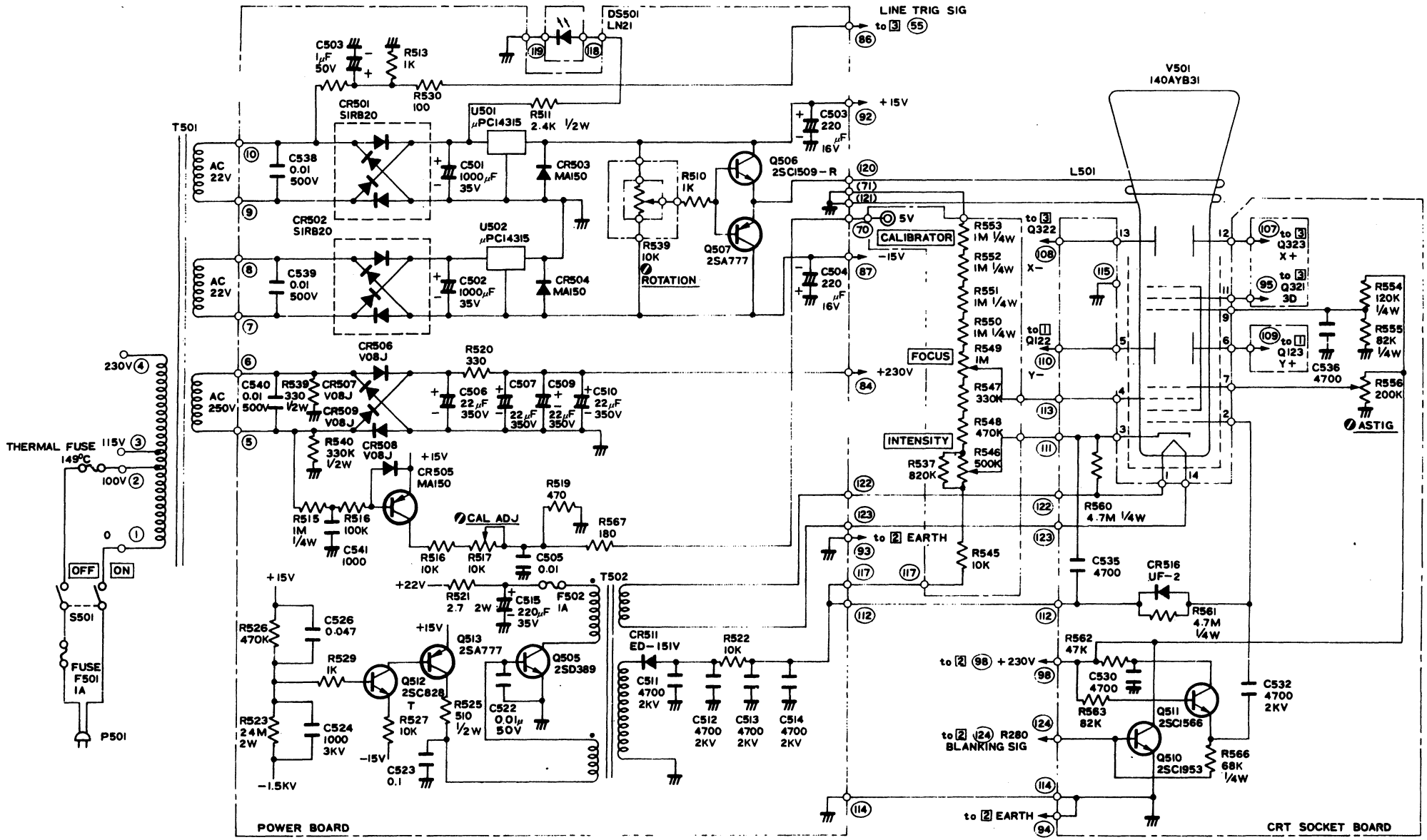
CH 2 PRE AMP & SW TCHING (A2)



5-30

VP-5102B

HORIZONTAL CIRCUIT (A3)



VP-5102B

POWER SUPPLY & CRT CIRCUIT (A4)